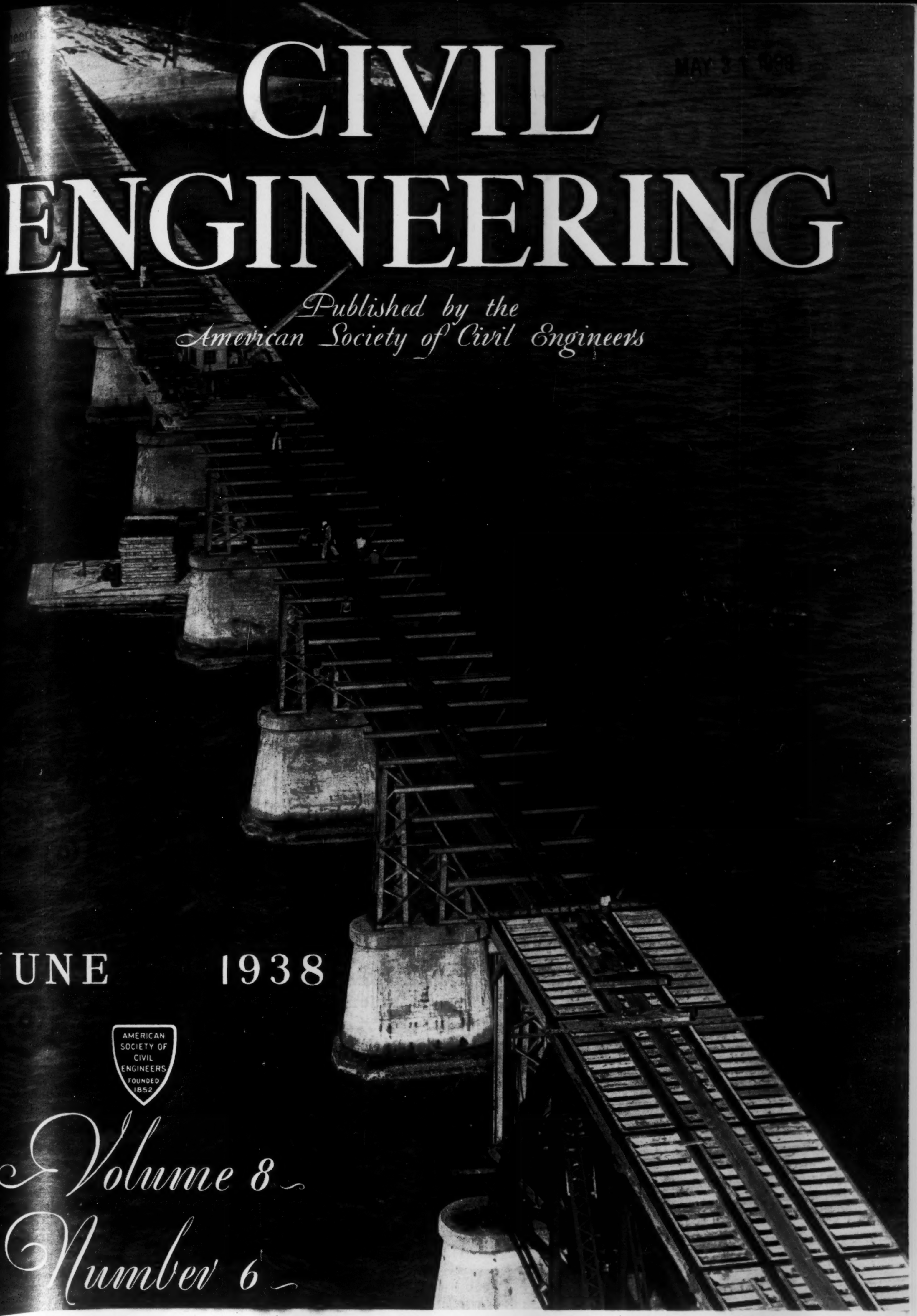

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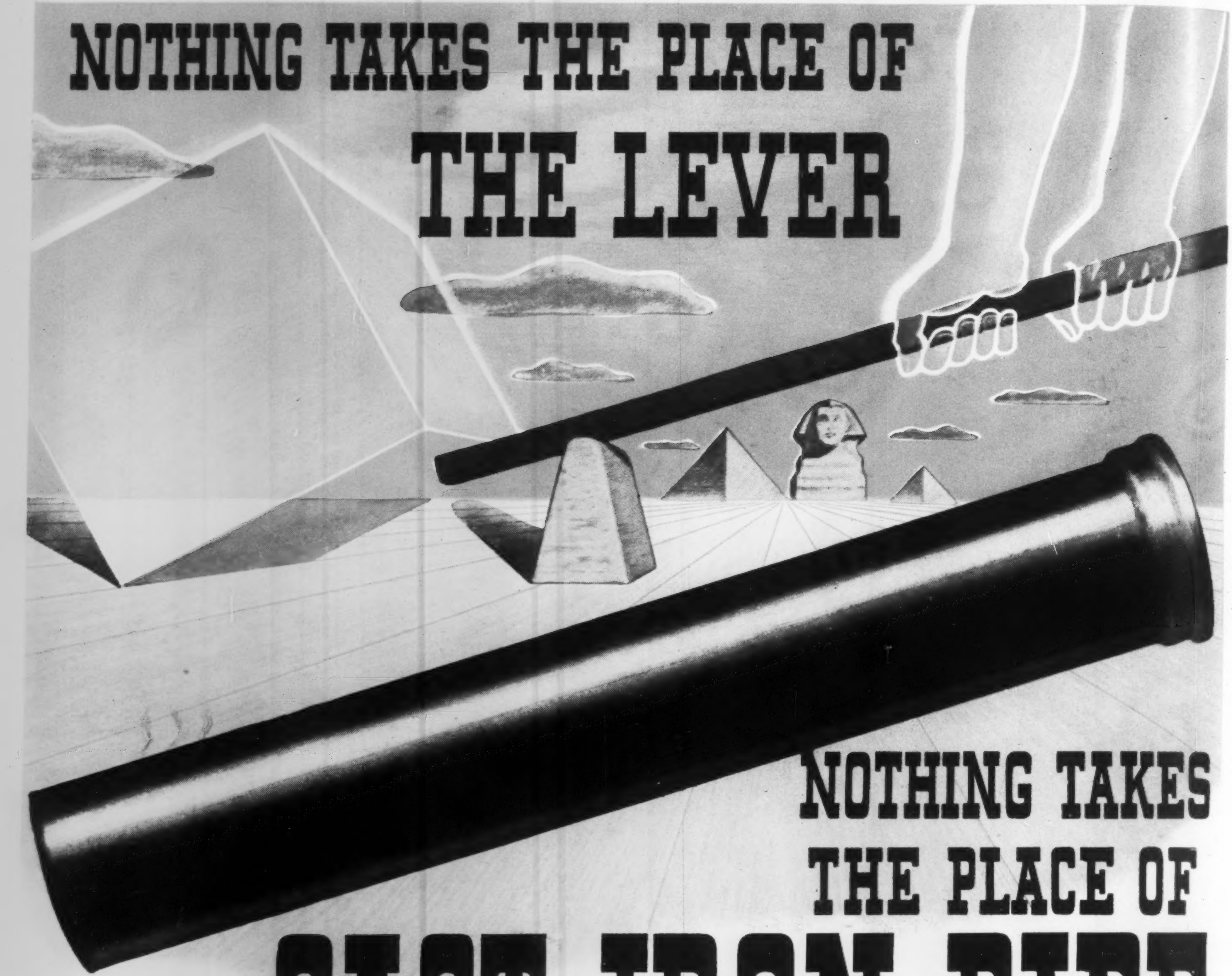
NOTHING TAKES THE PLACE OF THE LEVER



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Among Our Writers

R. B. **Ward** for nearly 25 years has been engaged in engineering and construction in the West—principally on large-diameter sewers, railroads in Alaska, and irrigation. Since 1931 he has been engaged on general designs, specifications, and construction for the Colorado River Aqueduct.

Frederick W. Newton is a graduate of Union College in civil engineering and of New York Law School. He started as construction engineer on railroad, water power, and Barge Canal work. After 14 years in engineering, he entered the practice of law, specializing in work of contractors.

Robert S. Thomas was appointed to the Military Academy from Tennessee in 1901. He served as lieutenant colonel and colonel in the National Army during the War. Returning to the Corps of Engineers as major in 1919, he served variously as district engineer at Mobile, Buffalo, and San Francisco, and as commander of the 3rd Engineer Regiment, and Department and Division Engineer (Hawaii). He left the Islands for his present assignment in March 1938.

G. D. Barnhart is a graduate of Cornell. From 1917 to 1925 he held various engineering positions with the New York Central Railroad. Then, after 8 years in private business, he was made supervising engineer of the Florida Local Control Survey. Since 1935 he has been executive and technical supervisor of the Florida Mapping and Geodetic Survey.

Richard K. Hale was graduated from Harvard in 1902 and Massachusetts Institute of Technology in 1904. He served in the Army during the World War, and was appointed to his present position in 1919. General Hale is a member of the Massachusetts State Planning Board and of the U. S. Beach Erosion Board.

Gilbert A. Youngberg has seen active service in the Philippines, Cuba, France, and various stations in the United States. In 1926, after a four-year tour as U. S. District Engineer for Peninsular Florida, he voluntarily retired to private practice, specializing in maritime engineering.

B. M. Duncan has been in engineering work in Florida since 1911, except for the war years, when he served with the A.E.F. From 1923 to 1928 he was city engineer of Miami; 1929 to 1933, state highway engineer; and later, consulting engineer to the state road department. He took up his present duties in 1937.

L. M. Clarkson, after service with the Virginia Health Department on malaria control engineering, joined the Georgia Department of Public Health in 1923. In 1926 he became its chief sanitary engineer and is now its director of sanitary engineering.

Charles M. Upham, Engineer-Director of the American Road Builders' Association, will soon complete his thirtieth year as a highway engineer. He has served as chief engineer of the state highway commissions of Delaware and North Carolina, and was employed for several years by the Massachusetts State Highway Commission.

Warren T. White is a native of South Carolina, a 1917 graduate of Clemson College, and served as an officer in the U. S. Army during the World War. For the past 15 years he has been with the Seaboard Air Line Railway in various capacities in development service—since 1927 as general industrial agent.

Lewis E. Staley graduated from the Pennsylvania State Forest School in 1906 and was with the Pennsylvania Forest Service until 1927, when he became the first State Forester of South Carolina. In 1931 he returned to Pennsylvania as Secretary of the Department of Forests and Waters. From 1935 to 1938 he was with the U. S. Forest Service.

Donald S. Wallace was born in British South India, and is a 1920 graduate of Yale. After a year with the Erie Railroad he entered the employ of the U. S. Geological Survey, with which organization he is still connected. He has been at Ocala, Fla., as district engineer since 1930.

D. B. Steinman is internationally known as an authority on the design and construction of bridges. Following 10 years of college study, he spent 12 years in alternate teaching and practice. Then, in 1921, he commenced his practice as a consulting engineer, specializing in the design and construction of long-span bridges. His work has extended to five continents.

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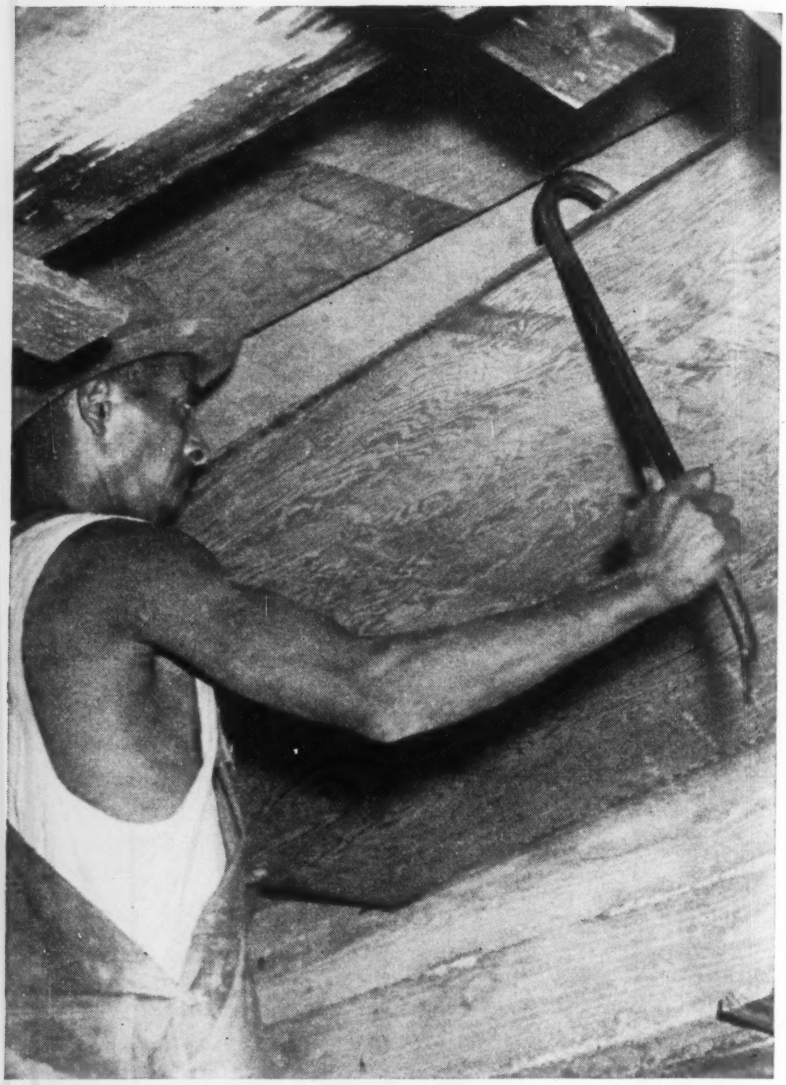

IT PAYS to figure the erection schedule which shows the lowest overall cost of time, forms and cement. Contractors' own figures in Lone Star's new book, "Cutting Concrete Costs," show net savings of 38¢ to $1.49 a cu. yd. of concrete on all types of concrete structures—simply by estimating each job with both Lone Star and 'Incor'. In some cases, 'Incor's 24-hour service strength figures the lowest; on others, it's Lone Star. But, either way, you get the advantage of easier-to-place concrete and good-looking finished work. Example:

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

A Young Engineer Takes Stock of His Profession

By WILFRED BAUKNIGHT
JUNIOR, AMERICAN SOCIETY OF CIVIL ENGINEERS
ASSISTANT ENGINEER, U. S. ENGINEER OFFICE, PITTSBURGH, PA.

IN a democratic country such as ours, success, generally speaking, is a reward which comes to individual capability, training, and initiative, augmented by opportunity, rather than from some predetermined plan. Our system of education for the engineering profession therefore must be generic in nature, ramified so that the young graduate will find himself with the proper foundation for any one of the various branches of the profession into which chance, or less likely, choice may throw him. In consequence, the young graduate must start out at the bottom in his particular field, as an apprentice, and his first view of his professional future thus emanates from this comparatively lowly point. If imagination and hope are not virile, and if confidence in himself and his profession is not persistent, the future may appear to be on the same plane as the present, and in such instance, discouragement and failure are inevitable.

After six short years of experience, I feel that many professional successes and failures are determined during the first few years after graduation—not successes or failures measured by pecuniary standards, as all may work side by side at first, but measured by innate honesty and confidence in oneself, in the incompleteness of our country and the attendant vast opportunities for service, and in the place that engineers will have in the future development of civilization. And it is believed that young engineers with adequate training and confidence in themselves can go far toward grasping the vision and enthusiasm necessary for ultimate success through observation and study of the lives and prophecies of the great men of the profession with whom they come in contact in their work, through the pages of our professional publications, and through the Society. It has been truly said that, while youth is important to the profession and the Society, the profession and the Society are more important to youth.

It is particularly gratifying to the Committee on Publications to present herewith a brief paper by one of the Juniors of the Society, in which some of the basic problems and difficulties faced by a beginner in the profession are noted and discussed. Its sound and constructive viewpoint should be of value to the younger members; it is also reassuring to those older members who look to the new generation to carry forward professional standards and ideals.

Youth Profits from Experience.—A lack of self-confidence is, in my opinion, the block over which many capable young engineers stumble in the early years of their professional life, and which they never surmount. It is easy indeed, when assigned to some mean task for months or years, to become disheartened and feel that there is no hope of advancement, no opportunity for self-expression, and that one is in an inescapable rut. But one need only turn to the life stories and prophecies of some of the great engineers of our generation, or review the history of some successful associate or acquaintance. From these sources the young engineer receives assurance that, with time, experience, personal effort, and adaptation to the vicissitudes that life may bring, he can slowly round out and enhance his capabilities, and that with this growth will come advancement in responsibilities and opportunities for service and self-expression.

Another common deterrent to advancement is the feeling that one is misfitted—that duties other than those at hand would be more satisfying. In this connection, the young engineer has been advised that he should not cling tenaciously to some specific professional objective set up by himself as a student, or at least early in life's work, accepting employment not leading directly to this objective merely as a means of existence until the desired opportunity is available. He is counseled to apply himself assiduously to the allotted task, at the same time taking opportunity to observe the work of those about him, and to keep abreast of the times by study and analysis. To see the wisdom of such advice one need only turn to biographies of some of the great men of engineering. Their experiences have been varied; their careers have been changed by vicissitudes that could not have been foreseen when life's work was begun; and the final magnificent services they rendered, have, in many cases, been quite different from those indicated by work early in their professional life. Advice, logically sound, and borne out by experience, must be worthy of acceptance and application. Many times fellow employees assert that they are just holding their jobs to tide them over until work "in their line" opens up. And many times these same men, with possible profound inherent capabilities, stick on year after year, making no effort to push forward. They are waiting for an opportunity that may never come, and, in the interim, are passing up far more promising ones which they are too blind to recognize.

What of the Future?～We young engineers have been told at times, particularly by those who would disparage the position of the engineer, that our country is complete, that new frontiers for development are a thing of the past, and that a period of adjustment lies ahead during which the engineer will have the task of executing the policies of others. This tends to discouragement. We do not crave honors and power, but we do want, when our perspectives have been adjusted and our actions guided and tempered by experience, to find the roads to new fields of endeavor still open, and to have a part in planning as well as executing the policies that are to guide this modern world ever forward. On this score imaginations and hopes are fired by those who are many years our professional seniors. These men, as they draw near the end of the way, presage ever-widening horizons for the engineer of tomorrow—for the young engineer of today. They envision the engineer as more articulate in the councils of men, and the profession as being called upon in increasing degree to design public policy and programs as well as public works. We are told that more time and energy must be devoted to the study of economic, social, and governmental problems, and that, with the methods and viewpoints of the engineer being applied to wider and wider fields, there is opportunity in the future for the engineer to exert even greater influence on the progress of civilization and the general well-being of man.

Federation Versus Individualism.～Here again we find something trustworthy, something tangible, upon which to build. The young individual with the true professional viewpoint is given renewed vigor in resisting the insidious influences of the resignationists in our ranks, who, losing all vision of the future and all appreciation of the great value to themselves and the profession of cooperation between planner and executer, choose to wring the greatest pecuniary reward out of today's hour of work.

It is in this connection thay many young engineers are now being called upon to make the relatively new, but important decision between unionism and individualism. Little dependence can be placed upon precedent or the experience of others, and each individual must make his own decision. Voluminous arguments are being presented on both sides, but I feel that the underlying principles can be stated quite simply. The union offers possible advantages for the individual who is resigned to life at the bottom of the ladder. Through union affiliation he may possibly make a particular job more secure for himself and increase his present monetary reward. At the same time, however, he will probably widen the gap between himself and his employer. On the other hand, the union can offer little but restraint to the young man with the ambition to get ahead—to the individual who desires to rise beyond directed detail, that is, to achieve a truly professional status.

Recognition for Engineers.～There can be little doubt that while the profession has been highly regarded in the past, the trend is upward. Engineers and engineering are becoming more widely recognized and more highly respected continually. This is as it should be, for certainly there is no group better fitted by training and experience for constructive thinking.

Yet we hear many individual engineers who have complaints to offer regarding lack of recognition. For the young engineer who entertains such complaints a course in self-improvement may be profitable, for often the trouble lies with him. Our profession and our Society can scarcely rise above the average level of the individual members, and we must be capable of greater responsibilities if we are to be entrusted with them.

Preparing for Leadership.～Looking toward their professional future, then, young engineers see opportunities and responsibilities. Their problem is to accumulate knowledge and sound judgment, through study and experience, so that when the duties of leadership devolve upon them they will be prepared. The highly respected and responsible place of the profession must be maintained, and it must be pushed forward as new fields are opened up. Here it will be incumbent upon the engineer to convince others, both in and out of the profession, of the soundness of advocated programs and policies. In my opinion many otherwise capable engineers fail to bring valuable ideas to fruition because of a lack of command of the written and spoken word, and of the ability to get along with other men. And with each individual failure, the profession receives a setback.

It is here that the Society can render one of its important services to the young engineer, and conversely that the young engineer can be of real value to the Society. He can enter into written and oral discussions in the local Junior group; in the regional group; and, to a more restricted degree, in national activities. In this way valuable training can be secured in presenting plans and ideas effectively. At the same time contributions of lasting value may be made to the profession. The Society will also serve to enhance the social nature of those who participate in its activities, thus helping to fit them individually and as a profession for a life in which, for greatest achievement, it is imperative that dealings with other men be handled with wisdom and understanding. For these, and many equally important reasons, it is felt that the value of the Society's place in the program of the young engineer cannot be overstressed.

Climbing the Ladder.～Young engineers must, of course, realize that success is relative—that there are natural limits beyond which we, as individuals, may not go. But we each have an individual ladder of possibility, the top rung of which is determined by moral and mental integrity, capabilities, willingness to expend effort, and opportunities.

If we give our best, applying the Golden Rule in all our dealings with our fellow men, we will find satisfaction, and opportunity for service in our work. And the leaders among us will push forward into those broader fields of usefulness of which our seniors foretell—fields in which all the rich heritage we have, and are continually receiving from our predecessors, must be amalgamated with a profound understanding of the present and a clear vision of the needs of the future.

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VOLUME 8

NUMBER 6

Construction Methods at Cajalco Reservoir

Control of Fill Materials and Scheme for Placing Paving Slabs Are Notable Features

FROM AN ADDRESS PRESENTED BEFORE THE LOS ANGELES SECTION

By R. B. WARD, ASSOC. M. AM. SOC. C.E.

SENIOR ENGINEER, THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, ARLINGTON, CALIF.

CAJALCO Reservoir, the main storage unit of the Colorado River Aqueduct System, was completed early in 1938. Its principal features include an earth dam 210 ft in height and an earth dike 94 ft in height, with a combined length of more than 1.8 miles. Care taken in the control of embankment materials is reflected in the report that the maximum settlement in the higher structure has totaled only 0.22 ft to date. Important steps in the construction are recounted in the accompanying article.

THE Colorado River project of the Metropolitan Water District of Southern California involves the construction of a main aqueduct 242 miles in length from the Colorado River near Parker, Ariz., to the Cajalco Reservoir, near Riverside, Calif., followed by a distribution system to deliver water in wholesale quantities to the 13 member cities comprising the District. Cajalco Reservoir, the main storage unit for the distribution system, is situated at a point on Cajalco Creek about 60 miles easterly from Los Angeles, the center of the Metropolitan Water District area, and 10 miles southwesterly from Riverside. The purpose of this reservoir is to afford protection against interruption of the flow of the long main aqueduct and to regulate the uniform flow in the main aqueduct to meet the fluctuating demands on the distribution system.

Several factors influenced the selection of the Cajalco site; one was that it is located on a stable granite formation at a safe distance from any important fault zone; another, that it was suitable for economical development; and a third, that at this site full development can be accomplished conveniently in stages to a maximum capacity of 225,000 acre-ft. The initial and present development, which was recently completed (February 1938), is for a storage capacity of 100,000 acre-ft. For the development of 225,000 acre-ft capacity, both dam and dike will have to be raised 49 ft.

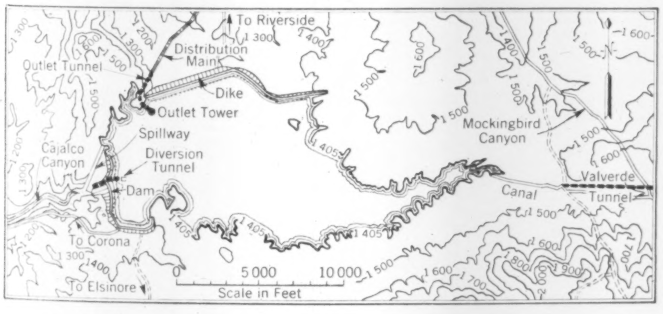


FIG. 1. CAJALCO RESERVOIR, WITH WATER LINE AS IT WILL BE WHEN THE FULL 225,000 ACRE-FT OF STORAGE IS DEVELOPED

The principal structures involved in the formation of the reservoir under this development are shown in Fig. 1. They include a diversion tunnel and an outlet tunnel, two earth-fill embankments (a dam across Cajalco Creek and a dike on a low rim along a part of the northerly side of the reservoir), a spillway, and an outlet tower.

The diversion tunnel, which is located under the north abutment of the dam, was used as a by-pass for flood water during the construction of the dam. It is 9 ft in diameter and 2,000 ft long, and is lined with concrete. Diversion was accomplished by means of an existing small concrete dam. The outlet tunnel, through which water is conveyed to the distribution lines, is 14 ft in diameter and 2,348 ft in length, and passes through the hill beyond the west abutment of the dike. Its lining consists of welded steel cylinders backed with concrete and lined with gunite reinforced with welded steel mesh.

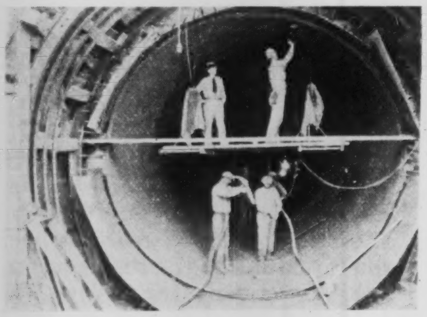
Construction of the concrete lining in both tunnels followed the procedure usually employed; that is, the concrete was pneumatically shot behind the steel forms (or cylinders), then puddled by men with boots and sticks. For constructing the gunite lining in the outlet tunnel, narrow-gage track was laid on the bare steel cylinders to transport equipment and materials. Sections of track were removed in advance of the guniting, and placing and finishing operations were carried on from scaffolds suspended from hooks welded to the cylinders. These scaffolds, which were raised and lowered by hand winches, were especially useful during the finishing operations, as it was necessary to go over the surface with steel trowels as many as four times in order to obtain the smooth surface required. Average progress on the gunite lining work was 70 lin ft of cylinder per 8-hour shift.

The dam and dike embankments were constructed of earth compacted in 6-in layers, and both have on the upstream slope a protective slab of reinforced concrete 8 in. thick. The slab is anchored to a cutoff wall along the heel, but is not connected to the parapet wall on the crest. On the downstream slope of the dam there is a rock blanket 2 ft in thickness, and along the downstream toe of both embankments there are tile drains. The principal dimensions of the two structures of the present development are as follows:

Item	Dam	Dike
Maximum height at axis, feet	210	94
Crest width, feet	50	32
Crest length, feet	2,170	7,575
Upstream slope	3 on 1	$2^{1}/_{2}$ on 1
Downstream slope—to within 50 ft of crest	3 on 1	3 on 1
Downstream slope—uppermost 50 ft	$2^{3}/_{4}$ on 1	$2^{3}/_{4}$ on 1
Earth-fill yardage	3,175,000	3,857,000

CONSTRUCTION OF DAM AND DIKE EMBANKMENTS

Work preparatory to the actual placing and compacting of material was quite different for the dam and dike embankments. The site for the dike was a flat ridge, high and dry, readily accessible, and with only a few trees and other small vegetation to be removed. The foundation rock was diorite and granite, mostly covered with earthy material to a depth of about 3 ft. This material was suitable for use in the embankment, but as it was low in density and too dry in its natural condition it had to be moistened and taken up, then redeposited and thoroughly compacted. Prior to excavation, borings and open-pit excavations were made at approximately 250-ft intervals over the entire foundation area, for the purpose of testing the materials and also to determine the depth to which it was necessary to excavate.



Placing and Finishing the Lining of the Outlet Tunnel

After the vegetation had been disposed of and the material to be removed and reused had been put into condition by sprinkling, the top soil was excavated with shovels and draglines, leaving about 10 in. of earth on top of suitable foundation. This bottom layer was then compacted by rolling 16 times with sheep's-foot tampers—the same method as was used for redeposited or borrow-pit materials. The total amount of material redeposited in the dike was about 250,000 cu yd.

At the site of the main dam, the creek-bed portion of the foundation was submerged in the reservoir of a small dam downstream. After the water had been drained out and the muck had dried sufficiently to be handled, excavation was carried on in a manner similar to that at many other dams. The total amount of excavation for foundation was 550,000 cu yd, all of which was used in various parts of the dam with the exception of 27,000 cu yd that contained a large percentage of organic material.

Stripping was carried down to the bedrock over the entire foundation, since diorite or granite of various degrees of hardness occurred at comparatively shallow depths throughout the area. Before any embankment material was placed, all dislodged rock fragments and other loose materials were removed. Generally, the final cleaning of the abutments was accomplished by means of compressed air. Very little trouble was encountered from wet foundations; in the few places where a small amount of seepage occurred, it was readily sealed off with compacted earth.

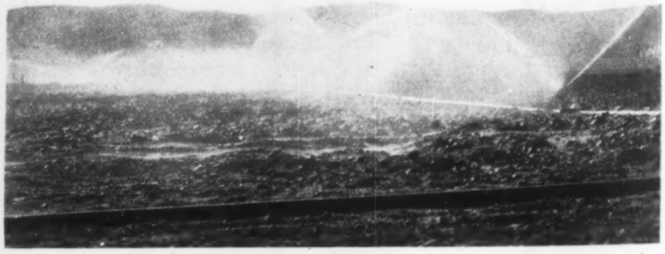
With the exception of the material obtained from parts of required excavations, the embankments of both the dam and dike were constructed of materials obtained from borrow pits located within the reservoir area at distances varying from $^{1}/_{2}$ to $1^{1}/_{2}$ miles. Most of the material in the borrow pits was too dry for use in its natural condition, so it was moistened in place prior to excavation. The wetting was usually successfully accomplished by the use of overhead sprinklers spaced at 40-ft intervals, although in places it was necessary to sprinkle two and three times in order to obtain the required moisture content. In some areas, where a thin layer of hardpan underlay the ground surface at a depth of about 3 ft, it was necessary to use the dike-and-ponding method because the penetration of the water was so slow. The depth of excavation in the borrow pits ranged from 4 to 55 ft.

Pneumatic-tired trucks having bed capacities of 10 cu yd were used to transport the material from the pits to the embankments, where it was dumped at regularly spaced intervals. The piles were roughly spread by dozer-equipped tractors, and the layer was then uniformly spread to a thickness of about 9 in. by motor patrol graders. Prior to the dumping of each new layer, all roadways formed by truck traffic were thoroughly broken up by disking, thereby ensuring good bond between layers.

In general, the material in the embankments was compacted by tractor-drawn sheep's-foot roller units weighing 30,000 lb. The spacing of the feet on the roller drums and the area of the tamping heads was such that there was a unit bearing of 280 lb per sq in. on the lowest transverse row of feet. Usually 16 trips of these units over each 6-in. layer were made to obtain the desired compaction. At parts of the embankment that were inaccessible to the roller units, pneumatic tools or one-cylinder self-contained gas-engine unit tampers were used to compact the fill.

Rocks in the borrow-pit material large enough to interfere with rolling operations were removed by hand and placed in the toe drains of the dike and the pervious section of the dam. A considerable part of the material obtained from the foundation excavation contained too many fines to be used in the pervious section and too many rocks to be used in the rolled embankment, but by passing it over a grizzly it was separated into two usable types.

The best monthly progress in embankment construction was 462,000 cu yd, with a maximum of 21,900 cu yd during one day (three shifts).



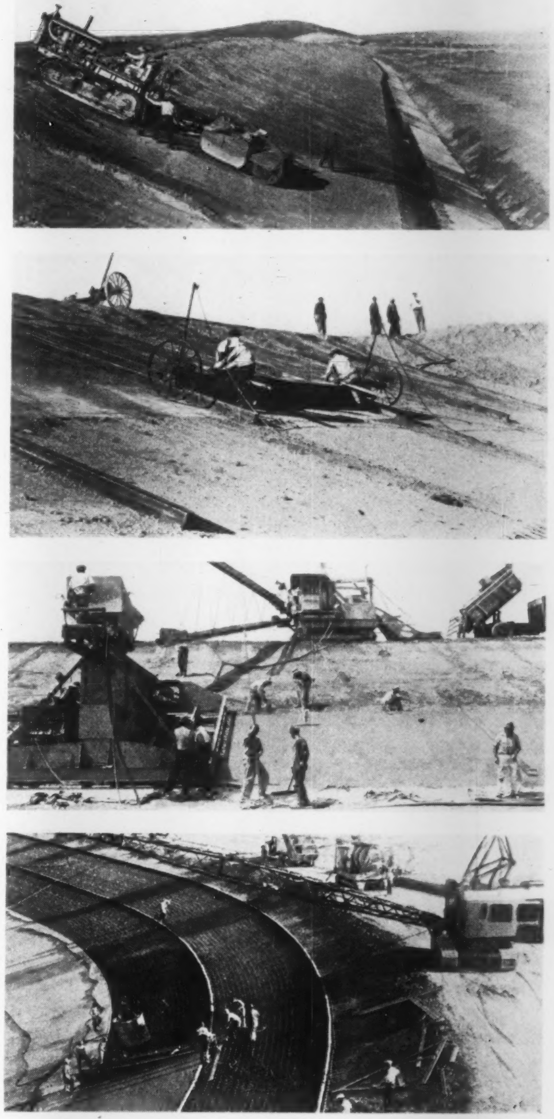
Sprinkling Embankment Materials in the Borrow Pit

TESTING OF EMBANKMENT MATERIALS

Definite control of the moisture content of all materials used in the compacted embankments was maintained, the object being to attain as nearly as practicable the optimum moisture content. Moisture tests were made prior to any wetting in the pits, and after each wetting; also on the subgrade of each layer in the embankments, on the material at the time of excavation, and again after it had been dumped and spread on the embankment. Any deficiency in moisture content after the final wetting in the pits was made up by hose sprinkling during the excavation and by the use of sprinkler trucks on the embankments.

Results of the moisture control and compaction were determined by making density or unit weight tests by the "Proctor method," at the rate of one test to approximately each 1,700 cu yd compacted. As a part of each density test, a sample of the material was placed in a standard compaction cylinder in three 2-in. layers, and compacted by striking each layer 25 firm blows with a $5^3/_4$-lb tamper. A direct comparison of the density obtained in the cylinder with that determined for the roller-compacted material gave a definite and immediate indication of the degree of compaction obtained in each part of the embankment.

The effectiveness with which definite moisture control and thorough compaction was practiced on this project is demonstrated by the fact that of 4,270 samples taken from the embankments, 48 per cent had a density equal to or greater than that obtained in the compaction cylinder. These determinations showed the average dry weight of the compacted fill in the dam and dike to be 126.3 and 121.9 lb per cu ft, respectively, and the average moisture content to be 11.0 and 12.4 per cent, respectively, with optimum moisture of 9.7 and 11.0 per cent. The average percolation rate of the materials in the dam and dike, expressed in feet per year under a hydraulic gradient of unity, is 0.01 for both structures.



From Top to Bottom, These Views Depict the Rough Grading, Fine Grading, and Concrete Placing on the Upstream Face of the Dike, and Concrete Placing on the Main Dam

The maximum settlement measured to date has been 0.22 ft for the dam over a period of five months, and 0.08 ft for the dike over a period of eight months.

CUTOFFS AND PRESSURE GROUTING

Excavation of the trenches for the cutoff or anchor walls at the heels of the dam and dike was carried down to firm tight rock at all places. The trench for the dam was made by drilling, blasting, and hand mucking; but along the dike, where the formation was mostly decomposed diorite or granite, about 80 per cent of the trench was excavated with a trenching machine. Progress with the trencher was extremely slow in places, even with frequent replacements of sharp teeth; however, an average progress of 70 ft per shift was made. The trencher excavation was 2 ft wide and averaged about 16 ft in depth.

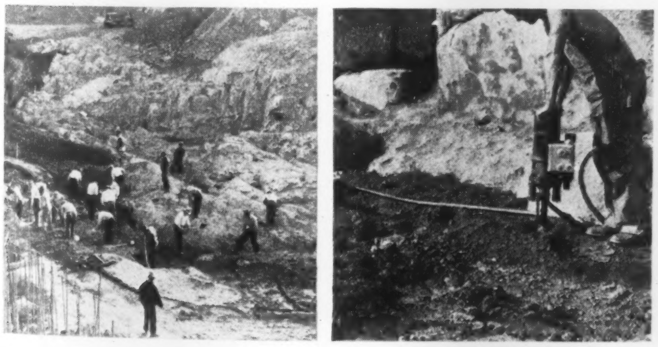
Through 2-in. pipes encased in the concrete of the dam cutoff wall, 2-in. grout holes were put down to depths of 30 to 200 ft at intervals of about 6 ft. Grout was forced directly to the bottom of each drill hole, through a $^3/_4$-in. pipe inserted in the hole. Connection to the top of each 2-in. pipe and a seal was made by a special head made of pipe coupling. Circulation of fresh grout was maintained by frequently withdrawing a small amount of grout at the top of the hole. The returned grout was remixed with additional water if necessary to maintain the proper consistency and again circulated through the pipe and hole.

With the exception of several narrow veins, the jointing of the rock in the dam foundation was tight and would not take much grout. The total quantity required, for the 16,513 ft of grout holes, was 3,643 cu ft, figured on the basis of one sack of cement to be equivalent to 1 cu ft of grout. The following tabulation shows the relation of cubic feet of grout forced into seams per foot of hole, to the depth of holes grouted:

Depth of Holes, Ft	Grout, Cu Ft per Ft of Hole
0 to 30	0.259
0 to 60	0.103
0 to 100	0.096
0 to 150	0.052
0 to 200	0.070

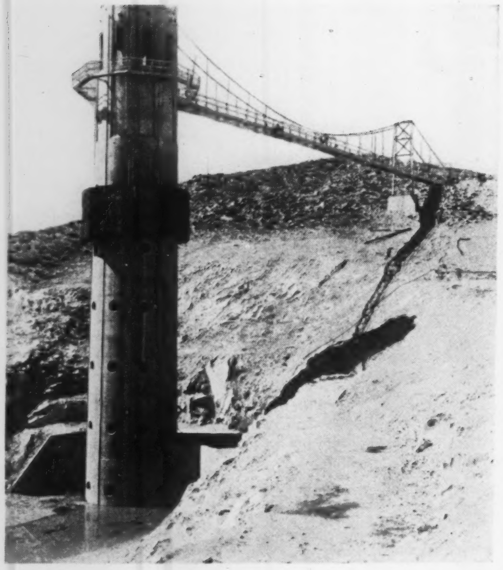
Along the dike cutoff there was only one short section of about 140 ft where it was considered necessary or advisable to do any grouting. In this section 14 holes were drilled for a total depth of 442 ft, and the amount of grout forced into the foundation averaged only 0.15 cu ft per ft of hole.

In most cases grout consisted of 1 part cement and 0.1 to 0.2 part bentonite mixed with 3 parts water. Grouting pressures varied from 20 to 100 lb per sq in.



Special Care Was Taken to Clean the Foundations and Abutments and to Compact the Fill Material in Places That the Rollers Could Not Reach

Bentonite was used as an admixture in grout because it materially retards the setting time of the cement; it also acts as a lubrication agent and aids in holding the cement in suspension. In a mixture of grout containing two-tenths parts of bentonite to one part of cement, the time of setting is 6 to 10 times longer than for neat cement grout. Bentonite is sold commercially in 100-lb bags containing approximately 2 cu ft and costs a little more than portland cement. It is believed that its use in grout has been confined almost entirely to Southern California.


THE OUTLET TOWER AND ACCESS BRIDGE
Note the Valve Openings and Fish Screens

CONSTRUCTION OF PAVING SLAB

In order to obtain full compaction of the embankment material at the line of paving slab subgrade, it was necessary to overfill approximately 3 ft in width. The excess or overfilled material was removed to within a few inches of subgrade line with dragline and scrapers, and the fine grading was accomplished by means of especially constructed scarifier and blade-grader units. Each grader was mounted on two wheels 24 ft apart, with the scarifier teeth or blade attached to a frame suspended from the wheel axles in such a way that the wheels could be raised, thereby permitting the frames to slide on steel headers spaced 20 ft apart and set to subgrade. For the trimming operation these graders, with cutting edges lowered, were dragged up the slope by a tractor; then the wheels were lowered and cutting edge raised, and they were permitted to roll back down the slope to the beginning of the cut. An extremely accurate subgrade was thus obtained, at the rate of about 9,600 sq ft per shift.

The 8-in. protective slab of concrete paving on the upstream slopes of both the dam and dike embankments was continuously reinforced with $^3/_4$-in. round rail-steel bars spaced 11 in. on centers both ways. The slab was constructed in strips 18 ft 9 in. wide, laid parallel to the axis of the dam and dike and with joints only at the end of a day's run. The only provision made for expansion in this slab was at the top of the embankments, where an asphalt-filled groove separated the slab from the parapet wall. Excavations under the slab showed a definite bond between the concrete and the compacted earth.

On the dike, the concrete was placed by a machine especially designed to operate on a slope of $2^1/_2$ to 1, and similar in principle to those used for constructing the aqueduct canal lining (see "Machines and Methods for Canal Construction, Colorado River Aqueduct," CIVIL ENGINEERING, February 1938). Good progress was maintained with this equipment; an average shift's work was 570 lin ft of paving. However, the machine was heavy and cumbersome and considerable time and equipment were required to move it from the finished end of one strip to the beginning of a new one.

On the dam, the paving machine was not used because of the many mechanical changes necessary to make it operate on a 3 to 1 slope—and also because many moves would have been necessary on account of the short length of paving strips. Instead, the concrete was placed by a crane equipped with a $1^1/_4$ cu yd bucket. All spreading and finishing was done by hand, and an average of 480 lin ft was completed per shift.

For both the dam and dike the concreting was carried on from the top of the earth embankment. Only the first two strips of paving below the top of any completed portion of the fill could be reached with the equipment used, so the program of embankment and paving construction had to be well coordinated.

The concrete in the paving slab was cured by two coatings of coal-tar-pitch cutback covered with two coatings of whitewash. The former sealed the moisture within the concrete and the latter reflected and reduced the direct heat from the sun as much as 20 deg.

The amount of paving slab constructed on the dam and dike is equivalent to an 8-in. roadway, 20 ft wide and 20.2 miles long.

SPILLWAY AND OUTLET TOWER

The spillway is located in a low saddle about 700 ft north of the dam. It is an uncontrolled overflow type with curved lip 200 ft long and has been designed for 11,000 cu ft per sec but will pass 15,000 cu ft per sec, which is considered ample to provide for runoff from the 40 sq miles of drainage area above the reservoir. The channel is lined with concrete for 560 ft below the lip and then passes through solid granite.

Releases of water from the reservoir will be controlled in a circular outlet tower 20 ft in inside diameter and 145 ft high. The concrete base is 60 ft in diameter and 16 ft deep and is founded on solid granite. Concrete for the superstructure was delivered to the top of each lift by a single-unit pump, the final delivery being against a head of 119 ft.

The control valves in the tower are double disk gates 30 in. in diameter, hydraulically operated. There are six tiers of these valves 17 ft apart, with five valves in the lowest tier and nine in each of the other five.

ACKNOWLEDGMENTS

Cajalco Reservoir was constructed under a contract with the Griffith Company of Los Angeles, and required 29 months. The entire Colorado River Aqueduct is under the direction of F. E. Weymouth, general manager and chief engineer; J. L. Burkholder, assistant general manager; and Julian Hinds, assistant chief engineer, all Members Am. Soc. C.E. The distribution engineer, R. B. Diemer, M. Am. Soc. C.E., is in charge of all work on the distribution system, including Cajalco Reservoir; the writer was resident engineer in charge of construction of Cajalco Reservoir; N. F. Crossley, assistant engineer, was in charge of all soil testing; and R. R. Proctor, M. Am. Soc. C.E., engineer of the Los Angeles Department of Water and Power, was retained as a consultant on the construction of the rolled earth fills.

COMPACTING THE FILL WITH SHEEP'S-FOOT ROLLERS

A Legal Step Toward Better Contracts

Court Decision Holding Owner Responsible for Sufficiency of Drawings and Specifications Points Moral for Engineers

By FREDERICK W. NEWTON

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THE important case of the Montrose Contracting Company against the County of Westchester (N.Y.) has just finished its long passage through the courts. Arising out of the terms of a contract for construction work, the case resulted in a decision that clarifies the responsibility of the owner to provide drawings and specifications which correctly describe the work to be done.

In 1931–1932 the contracting company built for the county a two-mile tunnel sewer under the streets of the city of Yonkers. The contract contained two items: (1) for the construction of a 78-in. sewer tunnel except partial compensation for work in compressed air; and (2) partial compensation at $30 per ft for tunnel in compressed air, but not to exceed 600 ft. The specifications set forth tunneling methods applicable to a free-air tunnel. They did not contain any of the usual provisions found in contracts for tunnel in compressed air. However, conditions encountered during construction were such that compressed-air work was necessary for over 6,000 ft of the tunnel. The Circuit Court of Appeals for the Second Circuit has rendered two opinions, both written by Judge Manton, in which it has been held that, by specifying methods of construction suitable for use in a free-air tunnel, but impossible of use in a compressed-air tunnel, the County warranted that the work was a free-air tunnel job except for the 600 ft mentioned in the contract. The judgment of the Court reimbursed the contractor for the difference in cost between a compressed-air tunnel and a free-air tunnel for this 6,000 ft.

Points in the decision which are of particular interest to engineers are found in the statements of the Court: (1) that whether the contractor was damaged in proceeding with the work in reliance on the warranty, or whether he was damaged in relying on the warranty in making his bid, he may recover; (2) that the contract provisions which attempted to place upon the contractor all the risks of the work could not be given the effect of completely negating the representation that the tunnel was primarily a free-air tunnel; (3) that such provisions might have been effective if the amount of compressed-air work had been somewhat more than the 600 ft mentioned in the contract, but not where the amount was over 6,000 ft.

It was shown that the County's engineers, when they prepared the contract, knew from their study of local conditions that from 3,000 to 6,000 ft of the tunnel would be in such material that compressed air would be necessary, and that they had been asked by one prospective bidder to rewrite the contract on a unit price basis. It is obvious that this would have been the proper procedure. Bids would then have been taken separately on free-air work and compressed-air work. The contractor would have been paid the fair value of the work done, and long and expensive litigation would have been avoided.

The case contains, also, a warning to engineers, that when they specify methods of construction to be employed by the contractor, as distinguished from the results to be obtained, the owner is responsible for the sufficiency of those specifications to obtain the result required. It is held in other cases that, if the contractor follows such specifications, he is entitled to be paid the contract price even though the result is not what the owner expected. It is held in this case that where the conditions were such that the specifications could not be followed, and more expensive work had to be done, the owner must pay the increased cost.

In an editorial published in *Engineering News-Record* in 1925 concerning a decision of Judge Woolley in the Passaic Valley Sewer case, which held the owner responsible to a contractor who had been misled by erroneous statements in the contract, it was said: "His decision and reasoning gives substantial aid to the movement for better contracts."

The present decision gives further aid to that movement, but more important still, it points the way along which engineers should proceed if they wish to render the maximum service to their clients. An engineering contract should present as accurate a picture as is possible of the work to be done. It should be sufficiently flexible to permit fair compensation for that work. It should not attempt to dictate the methods the contractor is to employ. It should not attempt to place upon the contractor all the risks, particularly those incident to underground conditions which the engineer may be able to ascertain in his preliminary investigation but which could not be seen by bidders in the short time usually allowed for preparing bids. If these few simple rules were followed, there would be fewer law suits arising out of construction contracts.

Throughout the litigation, the writer's firm handled the case for the Montrose Contracting Company, of which J. P. Carlin, M. Am. Soc. C.E., is president, and J. V. Hogan, M. Am. Soc. C.E., is secretary.

LEGAL HISTORY OF THE CASE

The first opinion of the Circuit Court of Appeals is reported in 80 Fed. (2d) 841. Application was made for certiorari, the State and the City filing a brief as friends of the Court. The decision denying the application is reported in 298 U.S. 662. The case was retried before Judge Leibell in the U. S. District Court and resulted in a verdict in favor of the contractor in the sum of $580,000. The County appealed, and the Circuit Court of Appeals affirmed the judgment with an opinion (94 Fed. (2d) 580). A second application, to the Supreme Court of the United States, was denied April 25, 1938.

New Military Roads

Areas Vital to Hawaiian Defense Are

By Robert S. Thomas,
Colonel, Corps of Engineers,

SCHOFIELD Barracks, on the Island of Oahu, has been called the "hub of a spoked wheel." Army engineers are now engaged in developing and improving the roads and trails that constitute the spokes. Areas vital to the defense of the Islands which hitherto have been inaccessible, or accessible only over vulnerable approaches, have now been assur-

Kole Kole Pass Road Winds Along the Side of a Rugged Volcanic Peak, to Reach the West Shore of the Island of Oahu, Hawaii

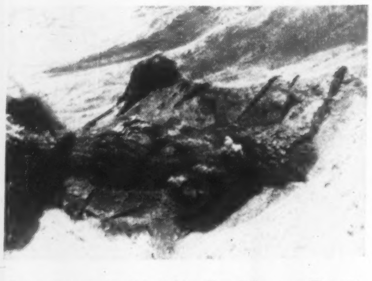
Placing a Coral Telford Base in the Red Land Section

THE Commander of the Army Defense Forces in Hawaii occupies a unique position with respect to the federal-aid roads in that territory. Although an agent of the War Department, he has an important influence over what roads are to be built jointly by the Territorial authorities and the Bureau of Public Roads under the Department of Agriculture.

The original Federal-Aid Road Act of 1916 enabled federal aid for road construction within the states, and the Federal Highway Act of 1921 extended federal aid to interstate routes. Neither act, however, allowed participation by Hawaii. Realizing that, in view of this fact, the roads vital to the military defense of Oahu would be provided only when and if Territorial highway funds were sufficient, the War Department in 1922 initiated action that resulted in the Act of March 10, 1924, which extended federal aid to Hawaii subject to the provision that "the Secretary of Agriculture shall give preference to such projects as will expedite the completion of an adequate system of highways for the national defense or which will connect seaports with units of the national parks."

To facilitate compliance with this provision, the War Department since 1934 has furnished the Department of Agriculture with lists of roads of military importance. Among these roads are some of great military necessity, but of doubtful value from the civilian standpoint and therefore not likely to receive prompt financial support from the Territory. One such road is the Kole Kole Pass Road, important to both Army and Navy, but of civil value only as a tourist route, if and when available to the public. It was the inclusion of this road within the roads of military importance which led directly to the establishment of the Emergency Relief Appropriation project for military roads and trails in Oahu. When, in the spring of 1935, it was learned that in addition to regular federal-aid funds a substantial allotment of emergency funds was made available to Hawaii for highways, the Department Commander, Maj. Gen. Hugh A. Drum, and the Commandant, Fourteenth Naval District, Admiral H. E. Yarnell, in a joint letter to Governor Joseph B. Poindexter, stressed the importance of the Kole Kole Pass Road to the Army and Navy and urged that it be included in the program for secondary roads under emergency funds then available. The Governor, realizing the embarrassment of attempting to deprive civil interests of money which had been assigned to the Territory, by allotments for the construction of a road essentially military in purpose, preferred to defer action on such an undertaking until he should at an early date visit the national capital. He volunteered then to explain personally to the appropriate authorities the necessity for Kole Kole Pass and other military roads with a view to obtaining an allotment of funds. Ultimately he succeeded in securing a total of $1,750,000, which permitted the Kole Kole Pass Road, the Wahiawa-Pupukea Road and certain auxiliary roads to be constructed and extensive work to be performed on other important roads of the island. Later an additional allotment of $500,000 of emergency funds for the Road and Trail Project was authorized to complete the road net and construct essential military trails.

Kole Kole Pass Road is an 18-ft (minimum width) paved road about six miles long, connecting Schofield Barracks with the Naval Reservation in the Lualualei pocket. It has a most important strategic value. The controlling grade is 8.5 per cent. The road starts at an elevation of 450 ft at its western end, rises to 1,635 ft at the summit cut, and drops to 1,063 ft at the eastern terminus. The sharpest curve has a 62-ft radius. The pavement consists of a macadam base 6 in. thick covered by a wearing surface of $2^1/_2$ in. of hard rock bonded by bitumen. The "out-of-pocket" cost was about $600,000, exclusive of the value of the services of military personnel employed on the work and exclusive of their indirect costs; the actual total cost, in round figures, was $650,000. The work was completed in approximately 18 months.



Loosening 31,000 Cu Yd of Rock in a Single Blast

This sub-project has involved the blasting away of mountainsides in order to make a shelf for the road along almost vertical volcanic cliffs. Over 300,000 cu yd of rock and earth was removed from its original location—but as some 30,000 cu yd of it was handled as many as five times, the equivalent of over one-half million cubic yards of rock and earth was moved. The most spectacular event of the job was a blast involving about 24 tons of explosives, which loosened some 31,000 cu yd of rock. The final removal of this material was a most

and Trails in Oahu

Made Accessible by Recent Construction

Member Am. Soc. C.E.
U. S. Army, Washington, D.C.

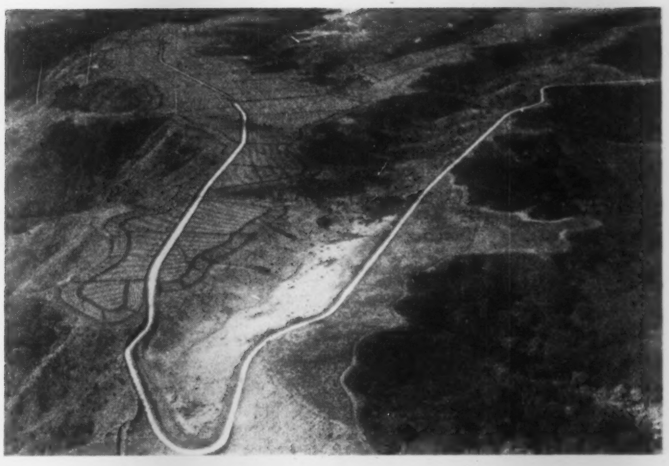
edly joined to the area of maneuverability of the garrison's arms and equipment. Colonel Thomas here records a variety of interesting facts, historical and technical, about the military road program. This paper was originally presented before the newly formed Hawaii Section of the Society, on the occasion of its first meeting.

critical operation. The blasted rock clung tenaciously to the mountainside and could not be undercut because of the risk of starting tremendous avalanches. Work progressed in general from the top downward in a system of terraces which required the handling of material some five times.

The Wahiawa-Pupukea Road winds through the gulches of northern Oahu for over 20 miles to connect two points that are about 8 miles apart in an air line. The pavement is of crushed coral, 10 ft wide, except for occasional turnouts about one mile apart. The main features of this work were the excavation of some 300,000 cu yd of material, mostly earth on steep hillside slopes, and the use of coral for pavement. Intense and frequent rains made the job very difficult. The cost of the road was about $26,500 per mile.

Certain phases of the work on both roads are worthy of comment. The multiplicity of agencies involved was probably the most noteworthy of all the administrative matters. Funds appropriated by the Emergency Relief Act were allocated by the Works Progress Administrator to the War Department. Responsibility for the work was placed upon the Commanding General of the Hawaiian Department, who in turn designated the Commanding Officer, 3d Engineers, as the officer responsible for the prosecution of the road and trail program. Ninety per cent of the employees were procured from the local Works Progress Administrator. Not to exceed 10 per cent of the personnel was permitted to be from nonrelief sources. There was a marked scarcity of young men with elementary engineering training. In work of this nature on the mainland, there would have been available a considerable supply of young graduates of engineering colleges to act as survey men, draftsmen, estimators, and inspectors. Very few young men of this type were available locally. Despite these difficulties the work was remarkably free from friction and confusion Both the administrative staff and the field forces were impressed with the thought that, in view of the immense volume of work to be accomplished with limited means in such a short time, it was essential to keep the rock and dirt moving and the plant continuously in operation.

Preliminary Grading on Switchback, Kole Kole Pass


Coral Surfaced Road Through Red Lands; Pineapple Field at Left, with Strips of Mulch Paper Between Alternate Rows

Water Can Pass Over This Road as Well as Under It

A most fortunate circumstance that enabled the administrative and supply functions to operate smoothly was the fact that the two engineer officers in charge of administration and purchases had special aptitude for their duties, and previous experience in similar assignments on river and harbor works of the Corps of Engineers. This is a marked example of the wisdom of the laws and policies that afford to engineer officers the opportunity to gain practical experience on large civil engineering works connected with the improvement of the nation's rivers and harbors.

A ratio of expenditures for labor to expenditures for materials, equipment, and supplies was fixed by administrative orders. Though assuring an expenditure of relief funds over a wider spread of unemployed, this was not conducive to most economical results when judged wholly by the standards of the volume of work accomplished for a given amount of money. On this particular project, where heavy machinery was most appropriate, a very slight change in the ratio would have produced much more economical results.

Weather conditions varied from the dry arid climate of the lee side of the island to that of the rain belt in the Koolau Mountains. During the period of operations the rainfall was considerably above normal. For months at a time it averaged from 6 to 10 in. per month—and in the maximum month it was 19 in.

Rainfall records indicated that very intense precipitation might be expected. In fact, the recorded maximum for this area is 25 in. in 24 hours. This affected the design of culverts and dictated that ample provisions be made for drainage and for adequate thickness of pavements. The abnormal rainfall during the working season especially affected the progress of the work owing to the fact that trucks hauling rock or coral for pavements could not pass over the muddy roads, nor could the pavement be laid on a soft, wet subbase.

Excavation involved the blasting of hard lava rock from the steep precipices, the removal of red soil from the steep-sided spur hills, and the blasting of the shallow, hard, crystalline, coral floor of an ancient reef. Subbase conditions included solid rock, dry coral reefs, red soil more like an ash than a clay, and black loam or gumbo. The roads and trails varied from unpaved pack trails 6 ft

FINAL GRADING OF SUBBASE THROUGH CORAL FORMATION, AND FINISHED BLACK-TOP ROAD

wide to the "black-topped" two-way highway of the Kole Kole Pass Road.

Much of the Kole Kole Pass Road was blasted from lava rock hillsides sloping from 30 to 57 deg with the horizontal. The chief rock formation consisted of gray or black lava flows forming a mass of basalt of varying degrees of hardness. The softest rock could be readily drilled and blasted. The hardest rock was a fine-grained, dense, black basalt, which occurred in dikes ranging from a few inches to 10 ft in thickness, and was difficult to penetrate with standard drills. Portable air compressors were used for nearly all the drilling and blasting, each drill averaging 7.6 ft per hour. Holes were spaced about 8 ft apart and drilled to approximately 2 ft below grade; the depth varied from 3.5 to 20 ft, with an average of 7.0 ft. Of the total 311,000 cu yd of rock removed, 32.3 per cent was blown off the road by the blasts. An average of 0.60 lb of dynamite and 1.04 lb of blasting powder was required per cubic yard of rock excavation. Dynamite was used as a detonator for large blasts of black powder as well as for springing holes and other purposes where a quick, shattering action was desired. Where seepage into the holes occurred during wet weather, dynamite was used in lieu of blasting powder.

UPPER END OF THE SWITCHBACK ON KOLE KOLE ROAD

Shovels Are Excavating Middle Bench of Switchback to a Grade of 7.5 Per Cent

Excavation of rock for a roadway of this kind includes two distinct phases: one is the rough excavation and the mass removal, and the other is the clean-up work, which includes bringing the shelf to more accurate grade, knocking off projecting masses on the side hills, and ditching in the rock sections. A considerable difference in cost of the two stages was noticeable on this job; the unit cost of clean-up was about twice the unit cost of mass blasting ($1.275 per cu yd as against $0.635 per cu yd). This difference appears to be due to several causes. Almost seven times as much drilling per cubic yard of rock was required for the clean-up and, although the cost of drilling a foot of hole was cheaper for the more shallow depths, the total cost of drilling per unit of volume was about twice as great. The clean-up work called for a greater amount of explosives—1.8 lb per cu yd as compared with 1.6 for mass drilling—but of greater significance is the fact that for the clean-up a greater proportion of the explosives used was the more expensive dynamite, required by reason of greater seepage from the wetter season and shattered rock mass. The unit cost of explosives was $0.302 for clean-up as compared with $0.165 for mass explosives, and the number of caps for clean-up was over three times the amount required for the larger charges.

The cost of blasting some 262,000 cu yd of rock by drilled holes amounted to about $180,000, or 68 cents per cu yd. In certain sections where intrusive dikes of extremely hard basalt occurred in profusion, the tunneling method of blasting was used. For the largest tunnel blast, 42,500 lb of blasting powder and 5,000 lb of dynamite were loaded into 17 chambers in a 726-ft network of tunnels. The blast loosened 31,000 cu yd of rock and was the largest in the history of the Hawaiian Islands. For each cubic yard of rock loosened by tunnel blasting, 0.21 lb of dynamite and 1.64 lb of black powder were used. The cost of blasting about 50,000 cu yd by this method amounted to some $22,000, or 46 cents per cu yd. It will be noted that mass blasting by drilling is about 38 per cent more costly than mass blasting by the tunnel method. The latter method, however, is not always adapted to local conditions and is ever so much more tedious and time-consuming. On the other hand where the cut is intersected by the very hard, intrusive dikes, the use of tunnels is almost imperative.

After drilling and blasting, more than half the broken rock remained on the road. It was generally in the proper sizes for removal by power shovels or bulldozers. The rock near the outside of the section was excavated by overcasting, and the inner part of the section was removed by rehandling with shovels or bulldozers. The $1^1/_4$-cu yd shovels handled an average of 48.6 cu yd of rock per hour of operation and the 1-cu yd shovel, 40.2 cu yd per hour.

In excavating the switchback section (where the largest blast had been made), a special method of handling the loose rock had to be adopted. Shovels and bulldozers could not work on the lower levels because of the danger of rock slides. One of the power shovels, rigged as a dragline, worked a 4-cu yd, V-shaped bucket between the shovel on the upper level of the switchback and anchors in the rock below the lower level. This unit was very effective in removing loosened material from the steep slopes so that the danger of slides was eliminated. Power shovels and bulldozers then completed the excavation.

The total unit cost of rock excavation (blasting, removing, and rehandling) was 76 cents per cu yd—distributed 47 per cent to labor, 28 per cent to materials, and 25 per cent to plant. All the costs given herein are field costs, including plant rental. They do not include administration.

Drilling Face of Steep Cliff, Kole Kole Pass Road, and Finished Road near Summit

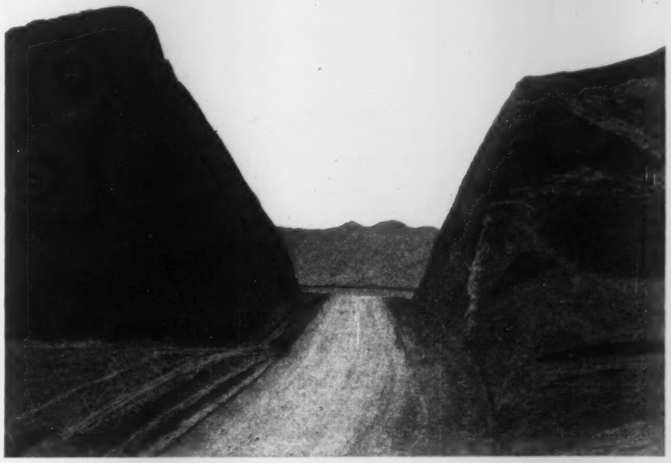
Drainage and subgrade conditions are different from those on the mainland. In general, there is an absence of clay, so that instead of shedding the water the soil has a tendency to absorb moisture. With heavy and frequent rains, it is practically impossible to maintain a dry subbase. The capillary action of the porous soil aided in forming veritable streams in the subgrade on long, continuous slopes. It was found advantageous on the bituminous roads to construct diagonal drains across the subgrade at frequent intervals. These were sometimes merely blind drains composed of broken rock laid in shallow trenches, but on the Kole Kole Pass Road, 6-in.-diameter open-joint tile drains covered with loose rock were used.

Various types of finished road surfaces were used. On the better class of roads, the wearing surfaces consisted of $2^1/_2$ in. of graded rock, bound and sealed by several applications of asphaltic emulsion. On some roads the base was of crushed rock; on others it was of crushed coral. On spur roads the wearing surfaces were constructed by applying a layer of fuel oil to the base course and then placing one or two layers of rock and asphaltic emulsion.

To economize in funds, the thickness of the pavement was reduced from the standard 6 in. of base course to 4 in. on the upper stretches of certain spurs. There has been only one break in the pavements of this reduced thickness and that one place is where subsoil conditions are poor; but the roads have been observed to wave under fully loaded five-ton trucks. On certain portions of auxiliary roads the thickness of the crushed coral pavement was only 3 in. So far, these pavements have withstood the light traffic to which they have been subjected. They do, however, show signs of failing to form sufficiently the mechanical bond desired in a road base. There is a slight tendency to spread or "squeegee" under heavier traffic. It is concluded that pavements should have not less than 6 in. of base whenever this thickness can be afforded.

This program has undoubtedly materially increased the combat effectiveness of the garrison; and there has been eliminated from the federal-aid program a large portion of those items which the military authorities have considered to be necessary "to expedite the completion of an adequate system of highways for the national defense," but for which, due to the lack of civil value, local funds have not been available to match federal-aid funds. The stage is now set for a further development of the federal-aid and military road system along cooperative lines and to the mutual advantage of civil and military interests.

Throughout the construction described in the preceding paragraphs, the Hon. Joseph B. Poindexter held the office of governor of the Territory of Hawaii. Maj. Gen. Hugh A. Drum, U. S. Army, commanded the Hawaiian Department from March 19, 1935, to July 31, 1937, when he relinquished command to Maj. Gen. Andrew Moses, U.S.A. Construction was initiated by Col. Virgil L. Peterson, assisted by Maj. Harry B. Vaughan, Jr., and was carried to completion by the writer, assisted by Capt. A. M. Neilson. Capt. Leland B. Kuhre acted as administrative assistant, and Capt. Harry O. Paxson had the responsibility for purchases, contracts, property, and supplies. First Lieutenants C. L. Landaker and W. F. Cassidy were in local charge of certain sub-projects, while Staff Sergeant Joseph Knopping of the 3d Engineers also supervised important phases of the work. Responsibility for collecting engineering data, computing quantities, and making topographic surveys was in the able hands of Master Sergeant Frank Wintera, 3d Engineers.



The Summit Cut, Kole Kole Pass, Is 86 Ft Deep

The Excavation (Earth and Hardpan) for This Notch Amounted to 33,000 Cu Yd

Progress of Control and Mapping in Florida

Comprehensive Program Begun in 1934 Is Supplying Much Long-Needed Information

By G. D. Barnhart

Assistant Director, Florida Mapping Project, Gainesville, Fla.

In 1934 only 6 per cent of Florida was adequately mapped. Since then that percentage has been doubled, and a surprising amount of horizontal and vertical control has been established throughout the state. The work has been done largely under WPA, and at strikingly low cost. Mr. Barnhart's paper, of which this is an abridgment, was on the program of the Surveying and Mapping Division on April 21, 1938, at the Spring Meeting of the Society in Jacksonville.

With the inauguration of the work relief program in 1933 the possibility of a program of control and mapping was actively considered in Florida as elsewhere. Since that time, through the sponsorship of the State Planning Board and the material support of the Engineering Experiment Station of the University of Florida, this work has been almost continuously under way. During the past two and a half years it has been financed and operated by the Works Progress Administration.

Prior to 1934 Florida was rather badly off both as to mapping and control. In the northern part of the state a moderate amount of first-order triangulation work had been done. Aside from this, there existed only a narrow band of triangulation around the entire coast—and it was not of extensive value other than for Coast Survey charts. Level lines throughout the state were also rather widely spaced. As for maps, only 24 of the 288 quadrangles covering the entire state had been completed, and seven of these were inadequate, as they dated from some time prior to 1900. This means that the state was 5.9 per cent adequately mapped.

Since January 1934 the status of both control and mapping in Florida has radically changed for the better. In 1934 and 1935 the U. S. Coast and Geodetic Survey extended the first-order triangulation to cover the entire shore line and also ran an arc north and south from Lake City to Lake Okeechobee. This gives primary control at about a 50-mile spacing. Since May 1935 the Florida Mapping Project, in cooperation with the Coast Survey, has established over 600 miles of arc of second-order triangulation. Through the WPA we are now executing first-order triangulation along the Florida-Alabama boundary, and when this arc and three shorter ones running south from it to the Gulf are completed, the ultimate object of the Coast Survey for primary control will be realized—that is, we will have 25-mile spacing of triangulation covering the entire state (with the exception of the Everglades area south of Lake Okeechobee, where such work is impracticable if not impossible). Every county will have one or more triangulation stations within its borders.

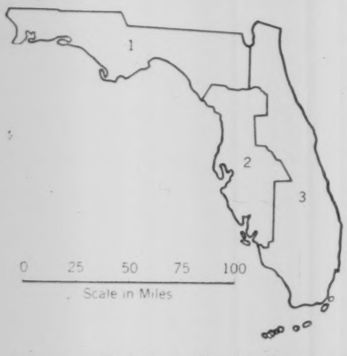


Fig. 1. Florida Is So Large That Three Separate Plane Coordinate Systems Are Required

In addition to this primary control there exists some 3,500 miles of second- and third-order traverse, and this network is being extended as widely and rapidly as possible, the ultimate objective being such spacing of the control stations that it will not be burdensome for any engineer or surveyor to tie his surveys to them. Meanwhile the network of levels is being extended by the Coast Survey, and in addition each of its traverse lines made since 1934 carries bench-mark elevations.

Since January 1934 eight quadrangles in the Waukulla National Forest have been mapped by the U. S. Geological Survey, which also mapped the St. Augustine quadrangle, including the ancient city. The Florida Mapping Project has mapped the better part of the equivalent of a quadrangle in Dade County and has made topographic maps of all state institutions, in addition to six quadrangles topographically mapped, and six others for which planimetric maps from aerial photographs are being prepared. We may now say that we have adequately mapped some 12 per cent of the state.

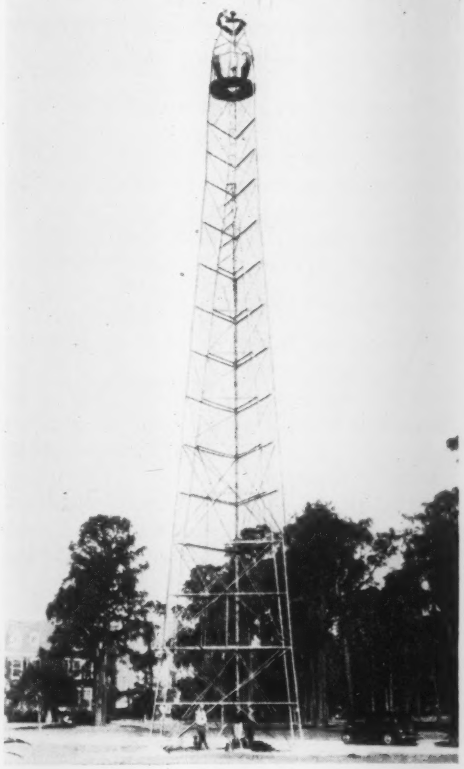
Of course, regardless of the method adopted for mapping, the control feature just discussed is a necessary preliminary. Owing to the flat nature of the greater part of the state, it is impossible to obtain contours on aerial photographs by the stereoscopic method to any great extent. We can, however, get very good planimetric maps from these photographs and then later add contours by other methods, or we can use the plane table and prepare the topographic map completely in the field. The latter method has been used by the Florida Mapping Project on all its work.

In connection with control, mention should be made of the state plane-coordinate system that was established by the Coast Survey in Florida a number of years ago. Because of the great area of the state, a single grid would not have given the required accuracy. Accordingly, the state was divided into three sections (Fig. 1), each having

Short-Wave Radio Brings Arlington Time-Signals Direct to the Field a separate coordinate system. For Section 1 the Lambert conformal projection, which holds its accuracy indefinitely in an east and west direction, was adopted. For Sections 2 and 3 the transverse Mercator system, which holds its accuracy in the north and south direction, was used. All three grids are correlated, the coordinates of points near the dividing line between two different projections being computed on both systems.

As control points with known coordinates become more numerous, it is logical for the engineer and surveyor to tie his surveys to this system, and he will thus establish coordinates for every point on his survey such that these points can never become lost even though all physical marks of the survey are destroyed. He need only start with one of two adjacent monuments whose coordinates are known, and using the grid azimuth (which can be computed from the differences in coordinates) he merely carries forward his survey by latitudes and departures; and, by applying these to the starting coordinates, obtains the values for his points. The fact that three state legislatures have already passed enabling acts for the use of this system, and that several other states are working on acts of this kind, is proof of their value. In Florida such an act was brought before the last legislature but failed to come up for final consideration. The act sought merely to make it permissive to use plane coordinates as a legal survey and description of property and was not mandatory in any way.

From time to time questions have been raised as to the accuracy of the control work being done by the Florida Mapping Project. This work is done according to the standards of the Coast Survey, and the results are submitted to and checked by that organization. It is worthy of note that when triangulation was first undertaken by WPA forces, only 25 miles of arc was contemplated, but the results of this were so satisfactory that the Coast Survey agreed to the completion of the triangulation of the state by these same forces.



EVERY COUNTY IN FLORIDA NOW HAS AT LEAST ONE TRIANGULATION STATION

This work alone, perhaps, is more than worth the money expended on the entire program, which has included in addition some 3,500 miles of traverse control and a large quantity of mapping. As for costs, it is interesting to note that the triangulation, traverse, and maps executed under the WPA from December 1935 to February 1938 cost only $216,000—which is 20 per cent less than the unit price estimates of the Board of Surveys and Maps for such a quantity of work. This is in spite of the handicap of the regulations under which WPA must operate. It should be remembered that many employees taken from relief rolls had to be trained in fundamentals, and practically all had to be trained in the extreme accuracy necessary. However, this training of numerous men is itself an asset to the state.

I would like to digress for a moment to emphasize the need for impressing on the layman the importance of accurate maps and control. To the general public a map is a map, regardless of accuracy and detail, and control has little if any meaning. It therefore falls on us as engineers to show the general public that there is as wide a difference between the sketch road map we all use and maps as referred to in this paper, as there is between the construction of a shack in the woods and the construction of a modern skyscraper. The importance of surveys and maps may be summed up by the statement that there is no construction, research, or planning problem which does not to some degree require accurate maps and surveys. And the fact that many of these projects come up in a hurry makes the quick availability of such maps and surveys of predominating importance. In truth, without them, the undertaking of some important work may not be considered feasible.

MUCH OF THE TOPOGRAPHIC WORK IS DONE BY PLANE TABLE

This View Shows the Process of "Sun Orientation"

Control bears the same relation to accurate maps that a steel framework bears to a large building. If we were to see several construction engineers start at different corners of a building, each using a datum of his own both horizontally and vertically, to construct a framework, we would instantly realize that there was something radically wrong, and that the floors would fail to meet by a matter of inches or feet and the walls likewise would fail to join up. However, we have been doing this very thing in our map making for a long time, largely because a correlated system of surveys has not been available.

Incidentally, we engineers have sometimes not made the best use of the information at hand. Many large cities have established bench marks and made maps based on a dozen or more different datums. Yet in many of these very cities there were available bench marks established by the U. S. Coast and Geodetic Survey. If these had been used, all the resulting confusion and unnecessary work would have been eliminated. Likewise the matter of horizontal control has been overlooked.

In conclusion I wish to emphasize again the substantial achievements of the Florida Mapping Project. It is to be hoped that engineers throughout the country will lend support to any program for similar work in their respective states, whether it is carried on by the WPA or any other organization furnishing relief, or whether it is absorbed in some regular government program.

Shore Protective Work at Winthrop, Mass.

By RICHARD K. HALE

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ASSOCIATE COMMISSIONER, MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, BOSTON, MASS.

EVEN the stern New England coast is not proof against the constant beating of the waves. At Winthrop, Mass., for example, beach erosion has demanded attention since houses first began to line the shore. The protection works, from the first seawall built in 1900, to the breakwater completed in 1935, are described here. This is an abridgment of a paper delivered before the joint session of the Waterways Division and the American Shore and Beach Preservation Association at the Society's 1938 Spring Meeting.

THE town of Winthrop is situated about $4^1/_2$ miles northeast of Boston. Its easterly shore, about 3.3 miles long, borders on Boston Bay and is exposed, without any shelter, to east and northeast storms (Fig. 1).

A study of the geological history of this section indicates that when the great Wisconsin ice sheet retreated, some 25,000 years ago, it left a great mass of drift, consisting of clay, sand, and gravel, with numerous boulders and stones of all sizes. In the drumlins—the smooth oval hills which are such a characteristic feature of the Massachusetts landscape—this drift or boulder clay was much compacted by the great weight of the ice, and where exposed, offers considerable resistance to attack by the sea.

James M. Bryne

"THE BREAKING WAVES DASHED HIGH"

Much of the drift was deposited on a surface which is now below sea level. There have doubtless been many fluctuations in the relative levels between sea and land since the retreat of the ice sheet, and the sea has probably been somewhat higher than it is at present in this area. Authorities still differ as to the evidence of the present trend; those who claim that any change is taking place believe that the land is sinking, with respect to sea level, at a rate not exceeding a foot a century. Such a change in elevation is too slight to affect the design of shore protective works.

HOW WINTHROP BEACHES WERE FORMED

As always happens in the case of drowned or submerged coast lines, the sea has attacked the headlands and washed the eroded fine materials along the shore, forming bars and beaches, with lagoons and salt marshes in the protected areas behind them.

As the headlands were cut away, large masses of boulders were left behind, forming a natural protective covering to the underwater slope, so that deep cutting now proceeds very slowly, and very little material is obtained for beach building. The beaches have receded and straightened to form a smoother shore line.

The northern part of Winthrop, known as Winthrop Highlands, is made up of a group of four drumlins. The easterly one, forming Grovers Cliff, has been badly cliffed, and more than half of it has been washed away; another one nearby has nearly disappeared; the third has been cliffed on the north side; and the fourth has not yet been attacked. Material from the group has drifted to the north to add to Revere Beach and to the south to form Winthrop and Shirley beaches. Opposite the center of the town is a single drumlin known as Great Head. Its top stands about 100 ft above high tide. About half of this has been washed away, leaving a mass of boulders, shoals, and bars exposed at low tide. At the southern end of the town, known as Point Shirley, there are remains of another drumlin, some 50 ft high, which was badly cliffed on the east and north before the accumulation of beach material protected it. It is 500 ft back from the present shore line.

To the southeast of Point Shirley lies Deer Island, a part of Boston, which like most of the islands in Boston Harbor was formed from one or more drumlins surrounded by beach sand and gravel from the eroded faces.

The natural drift of eroded material has been from the headlands in both directions. That is, material from Grovers Cliff moved northerly towards Revere and southerly towards Winthrop Beach; material from Great Head worked northerly towards Winthrop Beach and southerly towards Point Shirley; and material from the northerly side of Deer Island worked towards Point Shirley. The construction of protective works at Grovers Cliff, Great Head, and on Deer Island, has cut off this supply of material and there is little prospect of any increase in the amount of beach material available. The recession of Great Head has removed a natural barrier to the drifting of material, and it is probable that much of the fine material has been washed off Winthrop Beach and moved toward Shirley. Winthrop Beach above high tide is now largely composed of cobblestones, though there is some sand at lower levels.

Considerable portions of the beaches, as well as the headlands, have been protected with sea walls. The works to be described are characteristic of all those in this section.

In 1915 the Massachusetts Department of Public Works built a concrete sea

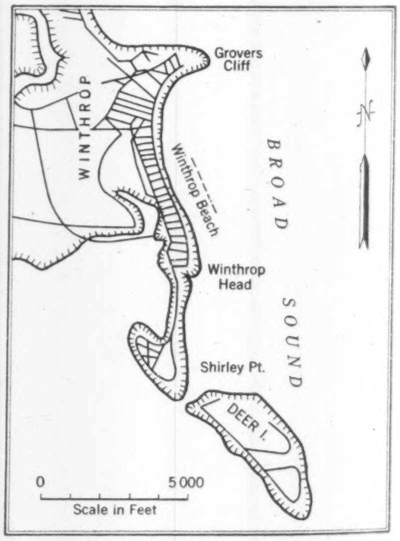


FIG. 1. WINTHROP BEACH

wall about 1,000 ft long on the Point Shirley shore. Details of the design are shown in Fig. 2. The face of this wall has been eroded somewhat by the beach material, but the timber groins show practically no deterioration and have proved effective in stabilizing the beach. There has been no tendency to undermine the wall and no noticeable cutting effect at the toe. The original cost of the structure was $20,000, or $20 per ft; and the total maintenance cost has amounted to only $2,000 in 23 years.

A considerable amount of water and beach material goes over this wall during severe storms—which probably would not have been the case had the structure been built to the standard height. In this connection it should be pointed out that the maximum observed tide in this district is 15.6 (as a still-water level); to this elevation wave heights must be added. It has been the general experience of the Department of Public Works that it is necessary to have the top of a sea wall 22 ft above mean low water to keep green water and materials from going over it, and even this is not high enough on a beach of shingle material. On such a beach storm waves will build up a shingle levee with its top 27 ft above mean low water.

STOPPING EROSION AT GREAT HEAD

To stop the erosion at Great Head, which had been proceeding at an estimated rate of about one foot a year, the Department in 1927 constructed a sea wall around the foot of the cliff, from 5 to 35 ft back of the high-water line. Details are shown in Fig. 3. The wall cost about $75,000 ($62.50 per ft), and there has been no cost of maintenance. There is a considerable area of boulder-strewn flats in front of this wall, which undoubtedly has a tendency to reduce wave action. Very little water and practically no beach material are carried over the top.

The construction of the Great Head wall has, of course, stopped all erosion of the toe of the cliff, but the face and top of the slope are still subject to rain and frost action. (The effect of this has not been excessive during the past ten years.) The wall was built as far from the toe as was deemed wise in the hope that the town would gradually place filling behind it to ease the slope.

The Winthrop Beach wall (Fig. 4) was built by the Metropolitan District Commission in 1900 in connection with the construction of a parkway. It extends between Grovers Cliff and Winthrop Head, a distance of about one mile, and is 30 to 80 ft back of the high-water line.

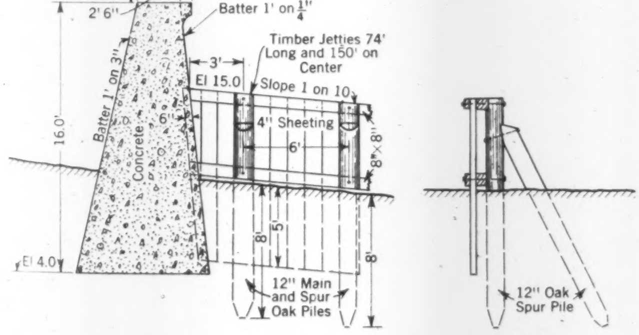
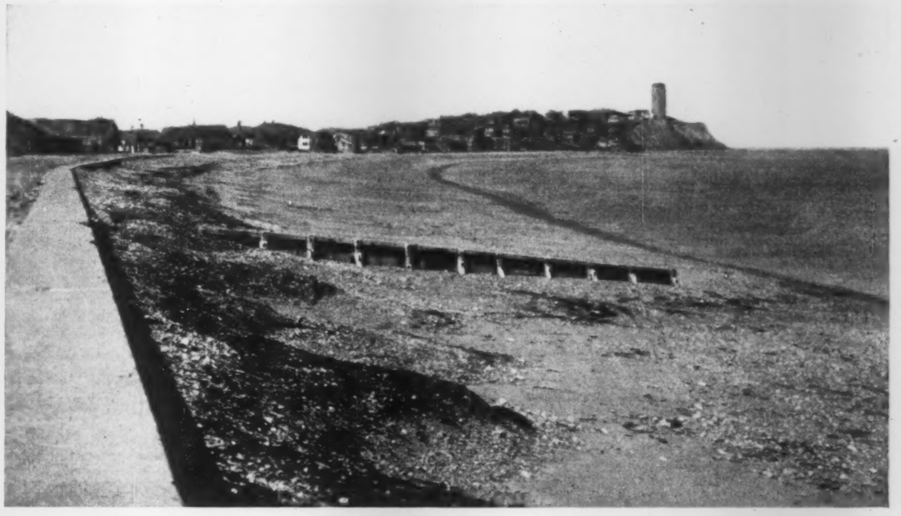


Fig. 2. Cross-Section of Point Shirley Wall and Timber Jetty



Looking North Along Point Shirley Wall

This structure was originally built of granite blocks with rubble backing, without groins, riprap, or other form of toe protection. It has been subject to very severe attack, and a number of portions have been washed out. In repairing the damage a more substantial section has been substituted, with concrete backing and with riprap to protect the toe. The top courses of stone have been fastened with iron dowels. Such work as has been done in recent years has been permanent and washouts have been confined to unimproved sections.

OFFSHORE BREAKWATER CONSTRUCTED

After considerable damage was caused by a severe storm in 1931, the Legislature directed the Department of Public Works to study the conditions and report on what action should be taken, giving special consideration to an offshore breakwater, which was much desired by the inhabitants of the town. The Department recommended that the height of the wall should be increased by a concrete addition $3^1/_2$ ft high, that riprap should be placed in front of the wall, and that groins should be built to prevent the beach material from shifting back and forth and possibly exposing the toe. The Department also submitted an alternative plan for an offshore breakwater at considerably increased cost.

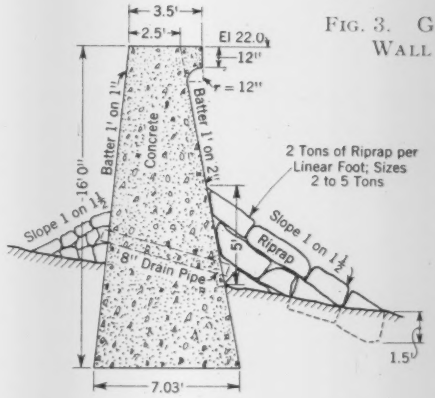

3.5'
2.5'
El 22.0
12"
r = 12"
Batter 1' on 1"
Concrete
Batter 1' on 2"
16'0"
2 Tons of Riprap per Linear Foot; Sizes 2 to 5 Tons
Slope 1 on $1\frac{1}{2}$
Slope 1 on $1\frac{1}{2}$
Riprap
5'
8" Drain Pipe
1.5'
7.03'

Fig. 3. Great Head Wall (1927)

Occupants of the houses and park officials objected to increasing the height of the wall because it would prevent people from enjoying the view from the much-used

DAMAGE TO WINTHROP BEACH WALL, 1936

NORTH END OF GREAT HEAD WALL

parkway. It was also believed that the riprap might interfere with bathing. Consequently the Legislature directed that the Department should construct the breakwater instead of adopting the plan suggested. This breakwater is shown in Fig. 5. The three northerly sections were built first as the water was deeper at the north end and the waves were higher. While this end of the wall had not been damaged as much as the southerly end, more water and beach material had been carried over it and greater damage had been done in that area to the roadway and private property. This part of the breakwater was completed in November 1933, and proved so successful during the following winter that the two southerly sections were soon added, being completed in January 1935. Later in the same year, the northerly section was lengthened 100 ft, giving a total length of 2,250 ft at mean high water.

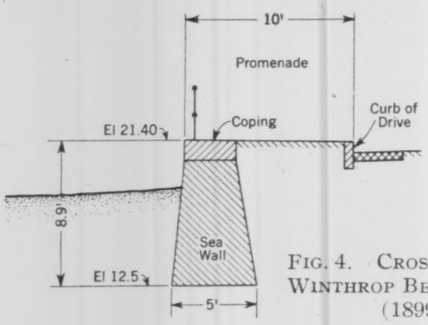


FIG. 4. CROSS-SECTION, WINTHROP BEACH WALL (1899)

In all, 111,000 tons of stone have been placed, the unit price averaging about $2.12 per ton in place.

The top of the breakwater was built in the form of an ellipse, with the stone blocks interlocked so as to offer little resistance to overtopping waves. There has been no displacement of these stones. The gaps in the structure were left to save stone, to provide for circulation, and to enable small boats to get through. They are not wide enough to permit the passage of a sizable wave.

This project has been effective in lessening wave action and in protecting the shore for a distance equal to its own length, with greater protection along the north part, where much less material has been washed into the street. There has been a tendency for the waves to work around the southerly end and wash out the beach just opposite. In this vicinity a 150-ft section of wall was undermined and destroyed during a storm in March 1938.

Surveys of the beach were first made in 1897 (before the wall was built), and have been repeated at intervals since then, the most recent being in 1938. The resulting cross-sections indicate that there has been no great change in the beach elevation back of the breakwater, but rather a shifting of the material back and forth along the beach.

An estimate based on a comparison of the elevations obtained in the 1931 survey with those obtained in 1937, indicates that the low-water line has moved offshore and that the area above the low-water line has increased by nearly 160,000 sq ft. A rough computation shows that there is an increase of about 90,000 cu yd of material above low water. There has been a loss of about 40,000 cu yd from the area between the 1931 low-water line and the breakwater, due largely to the seaward movement of the low-water line, as the change in average elevation of the underwater area back of the breakwater has been slight. This leaves a net gain of about 50,000 cu yd back of the breakwater in the period of six years between the two surveys.

It is believed that the construction of a new section to the south of the breakwater, a strengthening of the existing sea wall, placing of riprap at the toe, and construction of one or more groins will prevent further damage to the shore and loss of material from the beach. Of course, it would be practicable to bring in sand and build an artificial beach of suitable cross-section. Such work would greatly increase the recreational value of the beach and would add somewhat to the safety of the wall. It is believed that an artificial beach would be comparatively stable and suffer little wastage.

George H. Delano is the chief engineer of the Massachusetts Department of Public Works, and Francis L. Sellew is the district waterways engineer, responsible for the design and construction of the Great Head wall and the breakwater.

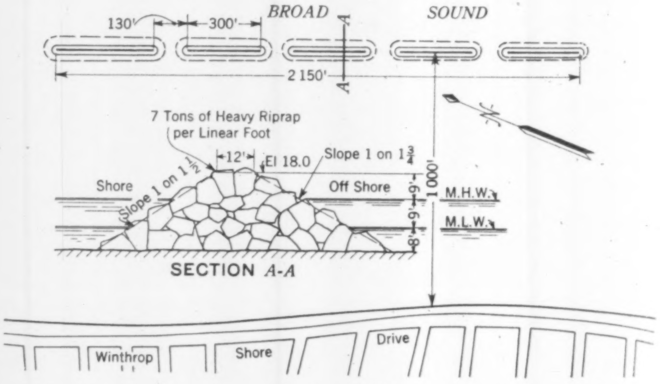


FIG. 5. LOCATION AND SECTION, WINTHROP BREAKWATER

Improvement of St. Johns River and Harbor

By Gilbert A. Youngberg
Member American Society of Civil Engineers
Colonel (Corps of Engineers), U. S. Army, Retired; Consulting Engineer, Jacksonville, Fla.

In these pages is presented a concise history of six decades of engineering work on the lower reaches of the St. Johns River, Florida. Between the lines, however, one can trace the development of the science and art of waterways improvement in general during the same period; for the gradual expansion of the St. Johns project, the modifications of the hydraulic theory involved, and the constant improvements in methods and equipment, are typical of what has taken place on many another American river. Colonel Youngberg's paper, of which this is an abridgment, was on the Waterways Division program at the 1938 Spring Meeting of the Society in Jacksonville.

The St. Johns River rises in a vast marsh in the east-central part of Florida, flows in a northerly direction for 257 miles to Jacksonville, and thence eastward 28 miles to the Atlantic Ocean. The normal fresh-water discharge at the mouth is 4,200 to 8,300 cu ft per sec.

The lower section (Fig. 1) extending from the highway bridge in the city of Jacksonville to the Ocean Bar—a distance of 28 miles—constitutes the so-called harbor of Jacksonville. For many years the bar at the mouth was the chief obstacle to navigation. It was first investigated in 1852–1853 by Lieut. H. G. Wright, U. S. Engineers, (later a general officer and Chief of Engineers, and an Honorary Member of the Society).

Lieutenant Wright reported that the channel was of the migratory type and that it shifted continually back and forth from north to south through a sector a mile wide. He reported a depth of 7 ft on the bar at mean low tide so that with a tidal range of about 5 ft no vessel drawing more than 10 or 12 ft could make the harbor, and then only on extreme high tide. He concluded that, unlike the bars at the mouths of the Mississippi River, the bar at the mouth of the St. Johns was not derived from sediment carried in suspension by the river currents but rather from the sands of the ocean beaches and shoals—these being subject to the normal constant action of waves and currents. His report was in part as follows:

"It seems to me that the only project that can be at all reliable is to confine to the channel the waters of the river that pass over the north shoal, by a breakwater running nearly parallel to the channel, and extending from the shore to as near the present bar as it can be carried, thus securing a much greater volume of water, and consequently a greater depth over the bar. That this would improve the bar, so long as the channel retains its present direction and position, there can be, I think, no question. . . ."

Lieutenant Wright further reported that to carry out the project fully, a jetty would be required on the south side of the channel and that, if the work should result in increasing depths over the bar, then some corresponding deepening would also be needed in the river between the mouth and Jacksonville.

Although the report is now 85 years old, it embodies the principles which have governed all subsequent navigation improvements.

No actual work was done for 19 years following Lieutenant Wright's report, but from observations during that period it was concluded that the migration of the channel had a cycle of about twenty-five years. Under the influence of the littoral drift, the channel would be forced to the southeast, and when the slope became too flat and the friction too great, a new channel would break through toward the northeast. The cycle would then be repeated (Fig. 2). This characteristic migration is now well understood but it was not so well known sixty or seventy years back.

For a number of years after the close of the Civil War Brevet Major-General Quincy A. Gillmore, M. Am. Soc. C.E., had charge of river and harbor improvements on the south Atlantic coast. Based on the survey of 1868 he submitted a report suggesting three possible methods of improving navigation on the bar of the St. Johns River. The first of these was improvement of the river proper by straightening, in order "to facilitate the inward, and consequently the outward, flow of tide," but in his opinion this did not seem to promise any certain or permanent improvement on the bar.

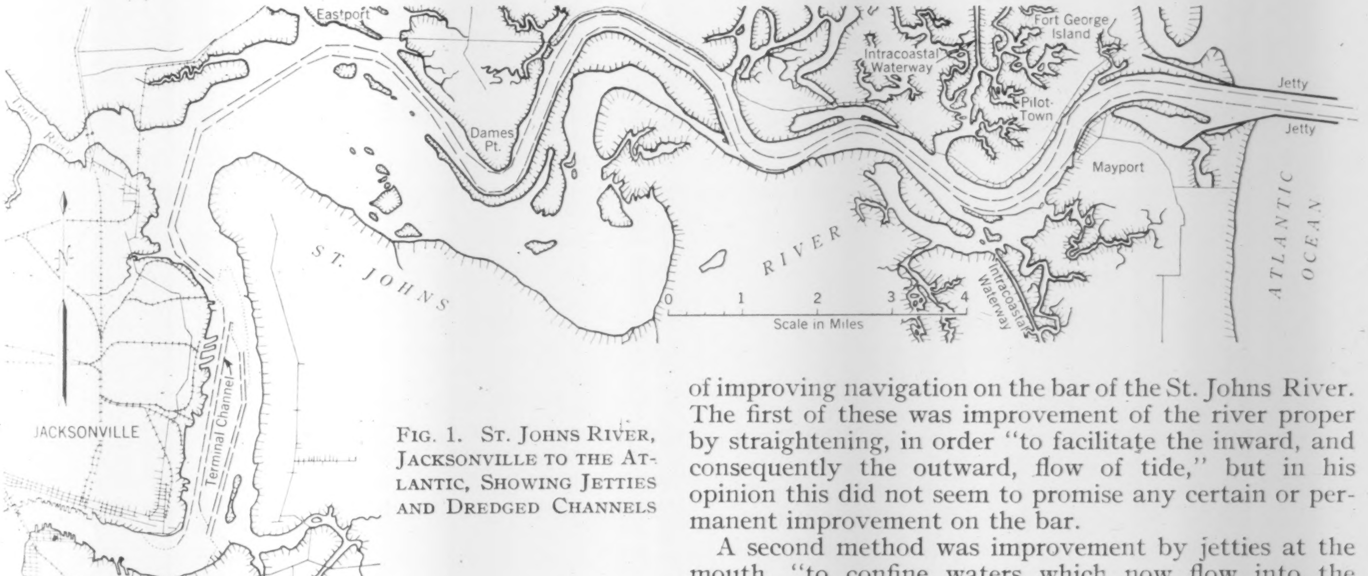
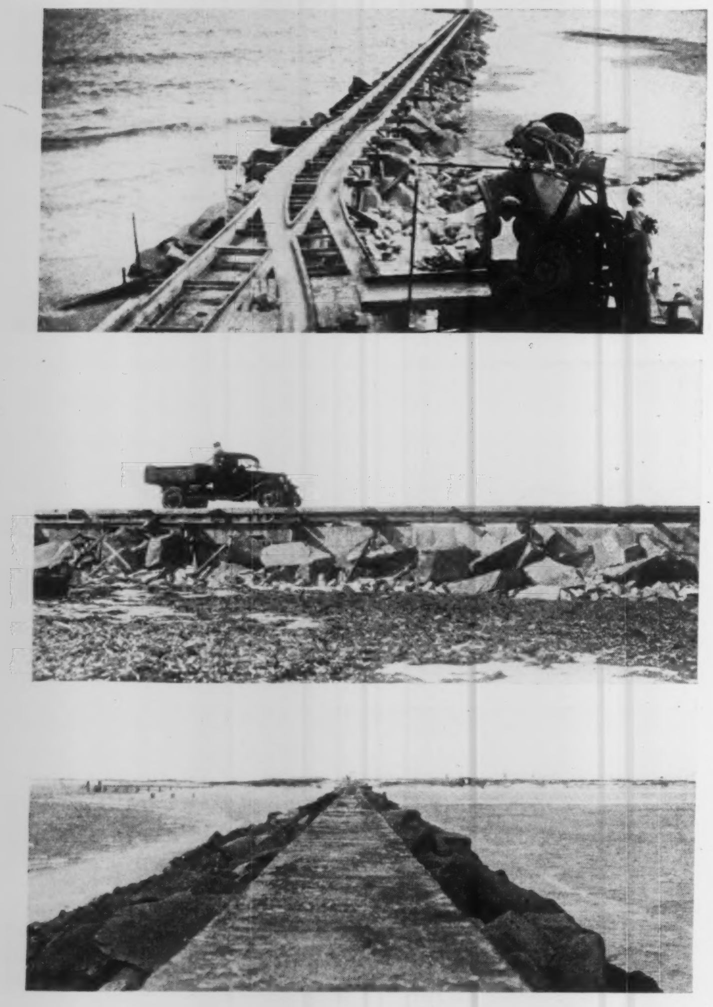


Fig. 1. St. Johns River, Jacksonville to the Atlantic, Showing Jetties and Dredged Channels

A second method was improvement by jetties at the mouth, "to confine waters which now flow into the ocean . . . over a waterway 16,630 ft in width so that they will be compelled to make their exit within narrower limits and consequently with increased velocity." General Gillmore did not then recommend the work because of its great expense and the time necessary for its completion.



"Stopping" the Jetties with Concrete, to Prevent Passage of Sand Into Ship Channel

From Top to Bottom: Trestle and Runway for Trucks Carrying Mixed Concrete; Concrete After Removal of Forms; and the Finished Concrete Capping, with Runway Removed

His third suggested method was "by repeated dredging or raking on the bar during the strongest stage of ebb current." He believed that a constant minimum depth of 10 ft at mean low water could be had at a cost of $10,000 per year.

During the early seventies Congress appropriated $50,000 for the improvement of the bar channel, and this was expended in dragging chains or other drags in whichever natural channel seemed to be the best at the time. In 1872 dredging was done by a side-wheel steamer, the *Henry Burden*—a privately owned craft, fitted with a 9-in. centrifugal pump and two 6-in. suction pipes passing over the stern, each equipped with a drag. Bins to hold the sand were constructed on the main deck, one on each side. The bins were sluiced out with clean water by laborers stirring up the sand with hoes. This seems to have been the first sea-going hopper dredge in the United States.

In 1874 General Gillmore reported he did not believe that jetties were practicable in the St. Johns bar or that dredging or dragging was of any permanent value. And then for about four years efforts were made to provide an outlet to the sea via the inland waterway to Fernandina.

This proposed route did not meet with favor in Jacksonville, and Capt. James B. Eads, M. Am. Soc. C.E., then building the Mississippi jetties, was retained by the city as a consultant. He submitted a report recommending two converging jetties standing well above the high-tide level. Merely as an expedient the *Henry Burden* was again put to work, with no idea that a permanent depth would be secured.

In 1879 General Gillmore also recommended permanent improvement works, to consist of two jetties projecting from the northerly and southerly banks of the river and converging until they were 1,600 or 1,800 ft apart at their outer ends, the idea being to cause scour to a depth of 15 ft at mean low water on the bar.

THEORY OF THE "DROWNED" JETTY

The north jetty was to be 9,400 ft long and the south jetty 6,800 ft long. (As finally completed the lengths are 14,300 and 11,183 ft, respectively.) Contrary to Captain Eads' recommendation, but under a theory then in vogue, the jetties were to be of the submerged or "drowned" type. The outer 2,000 ft of each jetty was to have its crest at half tide level, but the inner portion was to have its summit at about 3 ft below mean low tide. The theory was that the tide, rising freely in the open ocean, would flow rapidly over the jetties into the river estuary, and that little significance need attach to any scour by that portion of the flood entering between the outer ends of the jetties. Since the tide in the open ocean would recede rapidly, it was realized that, on the ebb, some portion of the tide would return to the ocean over the jetties but possibly at a lower velocity than the incoming flood tide, but also that the lower portion of the outgoing tide would be confined between the jetties and scour out the channel across the bar. There seems to have been some idea that the distance between the jetties at the outer ends should be such as to reduce the ebb velocity to that barely necessary to move the sand. It was feared that a greater velocity would induce an excessive scouring action and that it would interfere with the movement of incoming ships.

The jetties were to consist of riprap stone resting on a mattress of logs and brush. Logs and brush were also to be introduced in the jetty as hearting should it be found expedient. The total cost of the jetties was estimated at $1,306,409.

In 1880 Congress appropriated $125,000 to begin the work, and a contract was made with Capt. R. G. Ross at $12.49 per lin ft for mattresses 54 ft wide composed of a solid layer of logs covered with brush to a thickness of about 20 in., topped with a 15-in. layer of stone, making a layer about 3 ft deep. At the beginning of the work, stone was procured from New York City—its cost on board the vessel at that port being as low as 25 cents per long ton. The stone really served as ballast for vessels coming south to load lumber.

For a number of years, as Congress appropriated funds intermittently, the work was prosecuted by Captain Ross and other contractors. About 1885 Ross was confronted with a threat of infringement of a patent on the log mattress. He discontinued its use, but devised a brush-facine mattress, superior to the former type because of its flexibility. It also cost less to construct and was more easily placed in position.

About 1885 or 1886 the use of New York stone was discontinued and resort was had to the hard flint surface field stone found in the vicinity of Ocala, Fla. This small stone answered the purpose very well since the jetties were built only to the low-water level or less and thus were not subject to severe wave action. For a time it was placed in two ridges at the outer edges of each jetty and the space between was filled with oyster shell, which could be had in abundance and cost less than half as much. At first the shell was shoveled directly from barges into the water, but later the wastage was reduced by placing the shell in large paper sacks which were then lowered to their proper position. The shell was subsequently covered with small stone, and the submerged portions of the jetties were completed in this manner.

A 9-FT CHANNEL ACHIEVED BY 1886

The congressional appropriations were generally too small to permit real efficiency and economy. However, by 1886 the channel between the jetties had a width of 400 ft at mean low water and a central depth of nearly 9 ft. By that time, the south jetty showed a general settlement of 2 ft throughout, which was attributed to the destruction of the log-and-brush mattress foundations by marine borers. From that date no wood was used in the upper portions of the work. Mattresses do, however, seem to have been used subsequently for foundations, but wherever these may have been destroyed by the teredo they have been replaced in a measure by shells of oysters which found the original lime rock very much to their liking.

The north jetty, which was ultimately to base on Fort George Island, was projected across a so-called swash channel lying between the island and a nearby barrier shoal (Fig. 3). The initial work tended to arrest the southerly swing of the northerly ship channel and to scour off the southern edge of the shoal later known as Ward's Bank. However, it was not long before the northerly swash channel began to deepen, and it was decided to extend the jetty westward to connect with higher ground on Fort George Island. This extension consisted of two rows of palmetto piling 6 ft apart, well braced and filled with brush mattresses which were covered with stone. It was soon found that this was practically useless since it permitted the water to scour out the sand underneath the mattress, and the latter was too stiff to settle to the bottom. On the basis of this experiment the later mattresses for all purposes were made narrower and were laid in water 7 ft or more deep, at which depths the scour seemed to be less than at higher elevations.

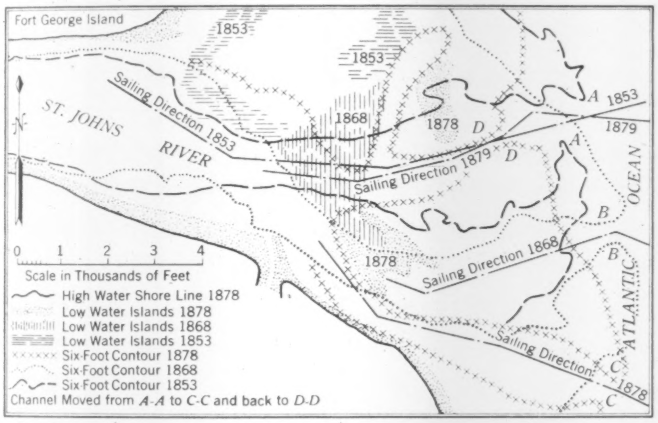

Fort George Island
1853
1853
Sailing Direction 1853
ST. JOHNS
RIVER
N
1868
1878
D
A
1853
1879
Sailing Direction 1879
D
A
OCEAN
B
1878
Sailing Direction 1868
B
ATLANTIC
Sailing Direction
C
1878
C
0 1 2 3 4
Scale in Thousands of Feet
High Water Shore Line 1878
Low Water Islands 1878
Low Water Islands 1868
Low Water Islands 1853
Six-Foot Contour 1878
Six-Foot Contour 1868
Six-Foot Contour 1853
Channel Moved from A-A to C-C and back to D-D

Fig. 2. The Ocean Bar, Showing the Shifting of the Channel Between 1853 and 1878

In the late eighties and early nineties the work was under the direction of Capt. W. M. Black, M. Am. Soc. C.E., who subsequently was the Chief of Engineers, U. S. Army, during the period of the World War. He was of a resourceful turn of mind and not averse to experimentation. He capped the inner ends of the jetties with concrete blocks weighing about 1,600 lb each. In 1891 experiments were made with concrete blocks weighing from 6 to 10 tons each, but later in that same year it was found that the 10-ton blocks on the north jetty had been displaced by storms. As a result of these experiments, it was definitely decided to use larger, heavier stone, and in subsequent contracts minimum sizes or weights were established and the specifications called for the stone to range from the minimum size up to 14, 16, or more tons—according to the capacity of the contractor's equipment.

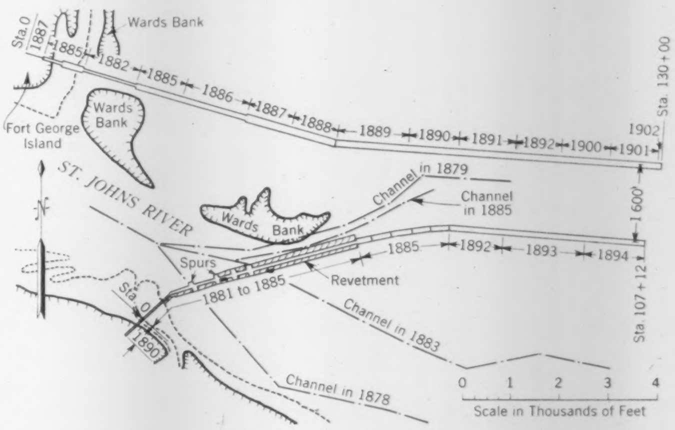

Sta. 0
1887
1885
1882
1885
1886
1887
1888
1889
1890
1891
1892
1900
1901
1902
Sta. 130+00
Wards Bank
Wards Bank
Fort George Island
ST. JOHNS RIVER
N
Channel in 1879
Channel in 1885
Wards Bank
1600'
Spurs
1885
1892
1893
1894
Revetment
Sta. 0
1881 to 1885
1890
Channel in 1883
Sta. 107+12
Channel in 1878
0 1 2 3 4
Scale in Thousands of Feet

Fig. 3. The Jetties; Numbers Refer to the Years in Which Various Portions Were Constructed

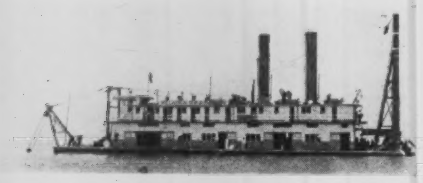
This large stone was all placed on the jetties by means of floating derricks, and under the influence of wave action the heavy boulders at the end of the fall would take on a terrific pendulum-like swing, which introduced a grave risk of capsizing the derrick. It required considerable skill on the part of the inspector and hoist operator to determine at just what point in the swing the boulder should be released in order that it might be placed in the jetty rather than wasted in the water alongside. In the course of years contract prices for the placement of stone ranged from $2.00 up to $6.75 per ton, and consequently many of the large granite boulders over which fishermen now swarm have cost the government more than $100 each.

By 1895 a 15-ft channel had been secured across the bar, and afforded depths exceeding those in the river—particularly in the vicinity of Dames Point. Funds for the improvement of the river between the bar and Jacksonville had never been made available by Congress, and in 1892 Duval County floated a bond issue of $300,000 for dredging and construction of training walls and protective dikes along the banks.

A 24-FT CHANNEL BECOMES NECESSARY

Meanwhile the commerce of Jacksonville had increased and the vessels had grown larger, thereby necessitating a consideration of further improvements. In 1895 the District Engineer recommended works designed to produce a 24-ft channel.

By that date the theory of the "drowned" jetty had proved untenable but, for lack of funds and lack of legal authority, little or no effort had been made to build up the jetties. Therefore in 1895 the outer end of the north jetty, which was nearly 11,000 ft long, was about 10 ft below mean low water. It then sloped upward for about 2,400 ft from the end, to the low-water plane. The south jetty was in a somewhat similar condition. The District Engineer concluded that if the jetties were raised throughout their entire lengths to the level of mean low water and all the flood and ebb waters were made to pass between them, the 24-ft channel could be produced and maintained at least as far out as the end of the north jetty. In due course funds were appropriated for this so-called 24-ft project. Thus the theory was abandoned that the entire tidal flow through the opening would be detrimental rather than advantageous.



THE WELATKA—A MODERN 24-IN. PIPE-LINE DREDGE

Designed Especially for Work on the St. Johns River, It Has Subsequently Been Used in a Number of Other Localities

The Ward's Bank shoal (Fig. 3) for many years had persistently tended to move southward across the channel, and considerable dredging had been required. To offset this southward tendency the 24-ft project contemplated a so-called training wall across the embayment just below Mayport on the right bank (Fig. 1). This wall was finally constructed about 1924. It consists of a stabilizing core wall of piles, brush, and stone; a sand fill placed by hydraulic pipe-line dredge; a protective covering of oyster shell; and a rock revetment. It has admirably served its purpose in guiding the tidal currents in the ship channel and scouring the southerly edge of the Ward's Bank shoal, thus preventing its encroachment from the north—though a moderate amount of dredging is still necessary.

IMPROVEMENTS SUBSEQUENT TO 1910

By 1910 the 24-ft project was practically complete, but in the meantime a need had arisen for a channel of still greater depth. On the basis of reports submitted by the U. S. Engineer Department, Congress adopted a project for a 30-ft depth from Jacksonville to the ocean and made the initial appropriation in 1910. The new channel was to follow the line of the 24-ft channel, and the depth was to be secured by dredging of sand, by excavation of rock, and by the construction of training walls and revetments. This project involved no new principles or methods.

With the increase of commerce and development of port facilities, local interests desired further improvement, and the River and Harbor Act of 1920 ultimately produced a survey report which was submitted in 1926, by the writer, then serving as U. S. District Engineer. The report stated that between Eastport and Pilot Town (Fig. 1) the channel curvature totaled more than two full circles, and that relief could be provided by widening the bend at Dames Point and the next bend downstream. However, such an improvement was not, in the writer's opinion, adequate for the expected expansion of traffic, and accordingly he gave consideration to rectification of the channel by dredging a cut across Dames Point for a channel 30 ft deep and 300 ft wide, and by similar work further downstream. He also recommended a realinement of the channel between the jetties, which then was in the form of a reverse curve and entailed considerable danger to vessels entering the port during northeast storms; and expressed the opinion that it would be advisable to check the movement of sand through the north jetty by filling the voids between the larger rock masses—the purpose being to cut off the supply and so reduce the amount of dredging to Ward's Bank shoal.

Higher authority very emphatically disapproved the recommendation for the major cutoffs, which would have eliminated 452 deg of curvature, and recommended instead merely the widening of the bend at Dames Point. The cutoffs were rejected on the grounds that they would result in excessive erosion, in some lowering of the lake section of the river above Dames Point, and in the creation of shoals, so that on the whole they would be detrimental rather than beneficial to navigation. These views were based on previous practice in river improvement work in which bends were eased rather than eliminated. Since then the U. S. Waterways Experiment Station has been established at Vicksburg, Miss., and model studies have been made of the St. Johns River. It is understood that these have definitely indicated that the proposed cutoffs would not, after all, prove to be so impracticable and destructive, but on the contrary would be helpful.

Part of the most recent work on the St. Johns River has been for the purpose of providing direct access to the terminals on the left bank between Commodore Point and Trout River. It has involved the dredging of a channel 400 ft wide and 30 ft deep, locally known as "Terminal Channel," widening of cuts further downstream, and a greater easing at certain other bends.

Within recent years the voids in the south jetty have been more or less completely closed with small stone, thus preventing the passage of sand into the ship channel. The movement of sand through the north jetty has been similarly blocked off by filling the voids with concrete. These works have been highly beneficial.

ECONOMICS OF THE PROJECT

Up to June 30, 1936, the total cost of improvements in the lower section of the St. Johns River had amounted to $16,250,000, of which all but about $300,000 had been borne by the U. S. Government.

And now, a word about the port itself. Jacksonville is an important distributing center for petroleum and fertilizer products, for paper, creosote, automobiles, coffee, canned beef, sugar, and other items which are received by water from both foreign and domestic sources. It has attained first rank as a market for naval stores and enjoys a large trade in the shipment of logs, lumber, fruit, and vegetables. In the six decades since the improvement was initiated, its commerce has shown a very large relative increase. In 1879 only 331 vessels cleared from the port with a net tonnage of 157,212 tons. The foreign trade had a value of a little over $100,000. In 1936 some 1,970 vessels cleared, with a net tonnage exceeding 4,767,000 tons. For 1936 the foreign commerce had a value of nearly $50,700,000, while the value of the coastwise trade exceeded $131,000,000.

The records show that the river improvements and the growth of the commerce of the port have proceeded *pari passu*. Every increase in the navigable capacity of the harbor and its ocean entrance has resulted in a corresponding and commensurate increase in the volume and value of commerce. Although "Old Hickory," whose name the city bears, was averse, on constitutional grounds, to "internal improvements" at the expense of the federal treasury, there is no room for doubt that the event has justified the Supreme Court's application of the Interstate Commerce Clause of the Constitution to waterway improvements in the interests of navigation and commerce. Certainly the expenditures on the St. Johns River have resulted in widespread national benefit.

The Overseas Railroad Becomes a Highway

Revamping 13 Miles of Bridges to Handle Auto Traffic Is Major Part of Florida Keys Project

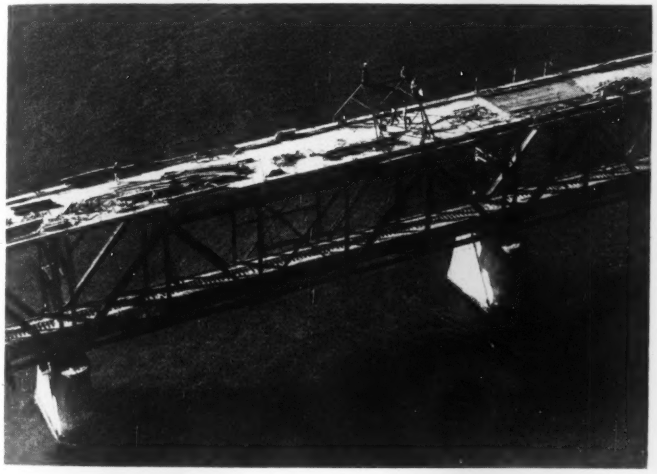
By B. M. DUNCAN

GENERAL MANAGER, OVERSEAS ROAD AND TOLL BRIDGE DISTRICT, MONROE COUNTY, KEY WEST, FLA.

KEY West, the city near the western end of the chain of coral islands known as the Florida Keys, is now the southern terminus of U. S. Highway No. 1. The auto road, opened on March 29 of this year, utilizes some 30 miles of bridges and embankments of the abandoned Key West Extension of the Florida East Coast Railway, and eliminates two 14-mile ferry crossings previously required of auto traffic. The story of this construction as told here is an abridgment of a paper presented before the Highway Division on April 21, 1938, at the Jacksonville Meeting of the Society.

THE islands composing the Florida Keys are of coral formation and vary in size from a few acres to approximately 25,000 acres. They do not rise many feet above sea level, and are separated by mud flats, shallow water, and numerous channels varying in width from a few hundred feet to seven miles (Fig. 1). Between 1922 and 1928 Monroe County expended about $4,000,000 constructing a highway from Key West to the mainland except for two water gaps of approximately 14 miles each. In 1933 the state legislature created the Overseas Road and Toll Bridge District, with power to sell bonds to complete the Overseas Highway and to construct, operate, and maintain a toll road between Lower Matecumbe and Big Pine Key.

After the 1935 hurricane destroyed about forty miles of the tracks of the Key West Extension of the Florida East Coast Railway, that company abandoned its line over the Keys and sold its right-of-way and structures to the District. The price of $640,000 was the salvage value to the railroad, but by the purchase the Bridge District effected a saving of approximately $10,000,000 on the construction of similar-type parallel highway bridges. A $3,600,000 loan without grant was secured from the Public Works Administration for this project, the District issuing 30-year 4-per cent revenue bonds.



THE HIGHWAY WAS CARRIED OVER THE TOP OF THE OLD BAHIA HONDA BRIDGE

In the distance of 44 miles between Lower Matecumbe Key and Big Pine Key there are 13 miles of bridges, and approximately 7 miles of embankment in shallow water. The bridges are of three general classifications: approximately 7 miles of concrete arch spans with rock fill between the spandrel walls; approximately 5 miles of steel deck plate girder spans; and approximately 1 mile of steel through-truss spans. In addition there are two movable spans, a steel deck-girder bascule span, and a steel through-truss swing span, each on concrete piers. Most of these structures were designed for Cooper's E-45 loading.

Six hurricanes in the last thirty years have failed to damage any of the bridges. All concrete piers were founded on rock with timber piling driven 6 to 10 ft into the rock. All the steel structures had been kept cleaned and painted, and there was no evidence of loss of metal due to corrosion except under the ties on the top cover plate of the girders. The plain concrete arches were in excellent condition. Except for a few washouts from the 1935 storm, the railroad fills within the District were also in good shape.

There are many ways of placing a roadway deck on such structures. The problem was to obtain an economical design that would suffer the least possible damage from a hurricane. The widening of the existing spans by widening the piers and extending the arch ring or adding girders would have been desirable from the standpoint of probable damage from hurricanes, but there were not sufficient funds for this purpose, nor was it considered justifiable from an economic standpoint. The solution appeared to be a flat roadway slab either of reinforced concrete or timber, with details arranged to minimize the loss in the event of a storm.

Whether or not to use reinforced concrete in this area required considerable study. However, an inspection of structures of varying ages in or near salt water indicated satisfactory life of reinforced slabs at an elevation above salt water similar to the ones encountered on our project, so that type of construction was ultimately adopted. Local rock was used for the concrete, but as no silica sand is available in this territory it was necessary to ship that material from the central part of the state.

There is no fresh-water supply within a distance of 90 to 130 miles of these structures. When the railroad was being built, efforts were made at first to bring in fresh water from the mainland, but the expense and uncertainty of maintaining a constant supply soon caused the engineers to

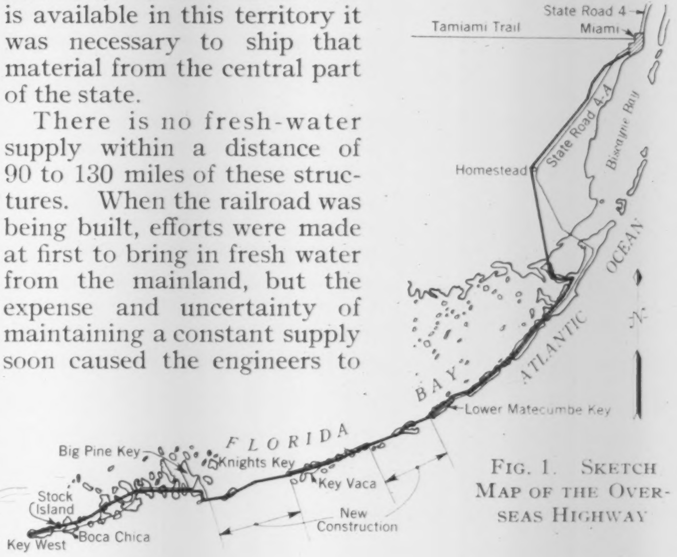
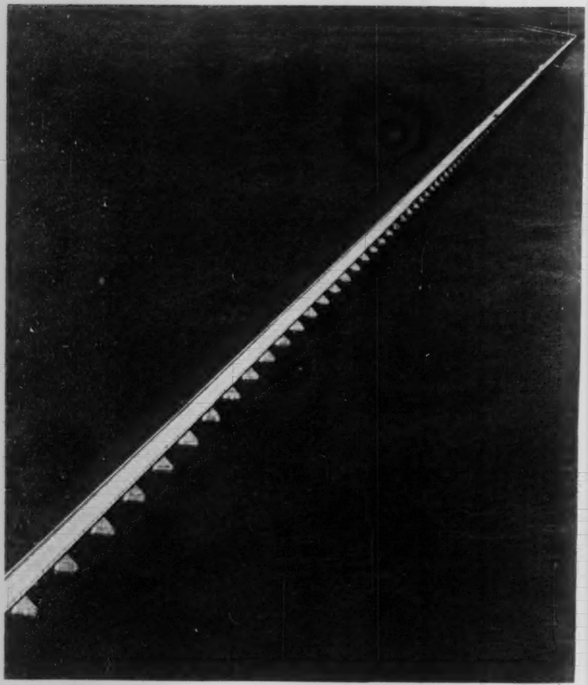


FIG. 1. SKETCH MAP OF THE OVERSEAS HIGHWAY



Looking Westerly from Knight's Key Along More than Five Miles of Deck Plate Girder Spans

abandon the attempt, and some of the concrete for the reinforced arches and all that for the plain arches was mixed with salt water. An inspection of the structures shows that this concrete is in excellent condition after twenty-five to thirty years of exposure, and the specifications for the new work accordingly permitted salt water for mixing concrete.

In reworking the railroad embankments for the new highway, existing grades were lowered to give a 34-ft width of roadway. Side slopes were varied to conform to the existing slopes. The new pavement is rock base surface treated using local material. The cost of the completed roadway on embankments is approximately $12,000 per mile.

Over the concrete arch spans it was first planned to have a flat slab the entire width of the new 20-ft roadway, with the 4-ft overhang beyond the spandrel walls reinforced for cantilever design. However, this overhang is susceptible to uplift by wave action in bad storms, and it was easy to visualize a loss of the complete deck if the slab was the full width of the roadway. As it was not considered feasible to anchor and reinforce the slab to take care of this possible uplift, this design was eventually discarded in favor of one giving assurance of a minimum loss in case of storm. In the final design (Fig. 2*a*), wide-flanged steel beams across the spandrel walls support small-unit reinforced-concrete slabs the width of the overhang.

It was found more economical to reinforce the curb as an outside beam and run the main slab reinforcement between curb and spandrel wall than to have the main reinforcing parallel with the curb. The bottom of the curb beam was kept flush with the bottom of the floor slab to avoid creating dead-air pockets under the slab and to simplify the form work. Cross-beams spaced approximately 8 ft apart appeared to give the most economical design. A construction joint was provided at each beam, and expansion joints were located approximately every 50 ft.

Where a concrete handrail is used, the slabs are kept in line by a stop angle at the ends of the beams; where a steel handrail is used, the steel posts serve in place of the stop angle. Two anchor bolts were placed in the spandrel wall in each slab unit to serve as anchors against any tendency of the slabs to crawl. Around that portion of the anchor bolts extending into the slab there was placed a 2$^1/_2$-in. cartridge filled in with asphalt, to permit a slight movement of the slab. A washer on top of the anchor bolt provides anchorage against uplift. As the outside edges of the slabs are not anchored to the beams, the anchor bolts in the spandrel walls will act as hinges in the event that storm action tends to lift the roadway. This flexible design should stand wave impact better than a rigid type.

An Existing Bascule Span with 16-Ft Clearance Was Widened to 21 Ft 4 In.

Between the spandrel walls a rock base with bituminous retread surface was laid directly on the railroad fill, without additional preparation except tamping the fill back into the trenches made for the steel beams.

The contract cost of this construction was approximately $24 per ft of complete bridge.

In the deck plate girder spans, the girders are 7 ft 9 in. apart, so some additional support for the roadway deck had to be provided. Spreading the girders apart was impracticable, as it would have required a wider cap on the piers and the cutting out and replacing of all bracing. An outside line of stringers supported by brackets from the existing girders was considered, but this design was

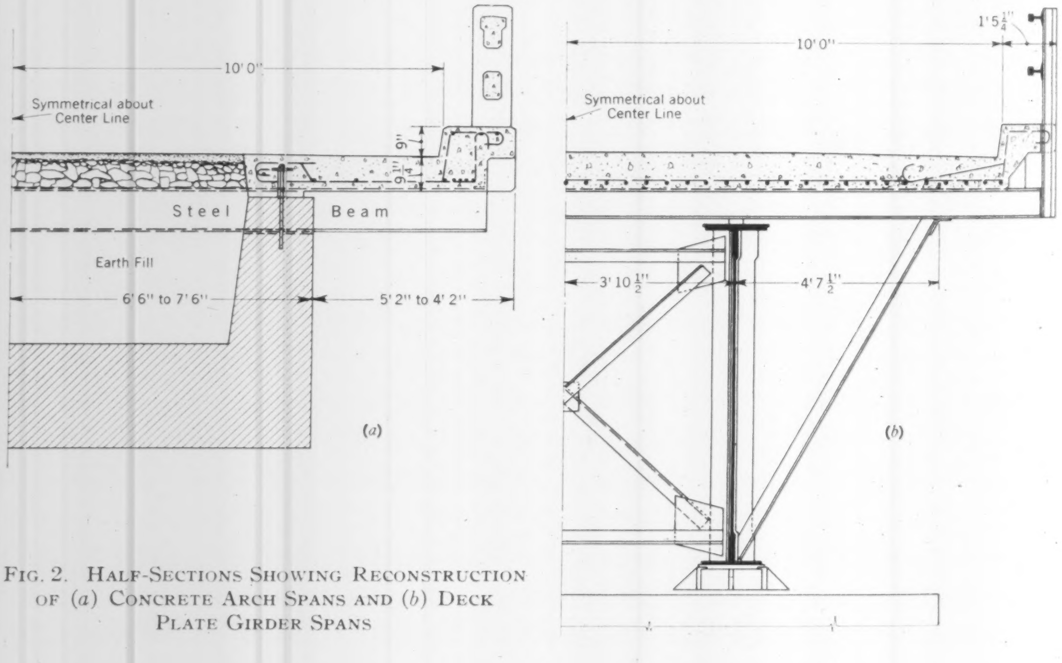
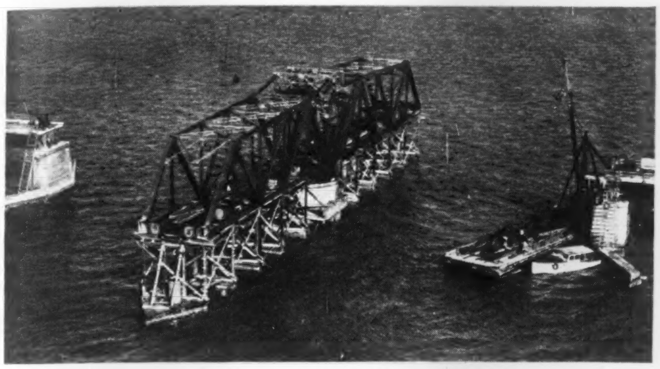


Fig. 2. Half-Sections Showing Reconstruction of (*a*) Concrete Arch Spans and (*b*) Deck Plate Girder Spans

abandoned in favor of a method that would permit a through circulation of air under the entire slab. The final design is shown in Fig. 2 (*b*). Wide-flange steel beams were placed across the girders at approximately 10-ft centers and supported near the ends by a T-brace extending to the bottom flange of the girders. The cross-beams rested on bearing blocks which centered the load on the cover plate and precluded removing or countersinking existing rivets. To avoid field drilling of the existing structural steel, all connections were welded. The entire design is such that the failure of any welded connection would result in the deflection of the beam and a cracking of the concrete slab rather than in the sudden collapse of any unit.

As the bottoms of these girder spans are all more than 18 ft above mean low tide and as the piers have rounded ends, there is little or no possibility of damage from wave action. A continuous 9-in. vertical clearance between the top of the girders and the bottom of the slabs prevents wind pressure being built up beneath them. The increased weight of the concrete slabs on the girders adds to the factor of safety against overturning due to horizontal wind pressures.



EACH OF THE TRUSSES OF THE SWING SPAN WAS JACKED OUT FOUR FEET TO ACCOMMODATE THE NEW HIGHWAY

The contract cost of this construction, including the cleaning and painting of existing steel, was approximately $31 per ft of complete bridge.

All the truss spans, except the swing span, are in the Bahia Honda Bridge, which is approximately one mile long. To provide two-way traffic where there was but 14-ft horizontal clearance, several designs were considered: a double deck, side lanes, spreading of the trusses, and placing of two lanes over the top. Single lanes, either double deck or on the side, were objectionable from the traffic standpoint as the stalling of a car would completely block one line of traffic. Spreading the trusses was feasible, even though it necessitated widening the piers. However, the design with two lanes over the top was found to be cheaper by about $100,000, or 20 per cent, and was adopted.

A new floor beam at each panel point was seated on pedestals of fabricated structural steel welded to the cover plate of the top chord. At the ends of the trusses, rolled sections seated on the existing end floor-beam hanger posts were used as columns to support the new end floor beam. Stringers in the intermediate panels were framed into the floor beams with riveted connections, while the stringers in the end panels were extended over the end floor beam to an open joint. A reinforced-concrete floor is placed on the stringers.

The cost of the complete reconstruction, including some work on a number of deck-girder approach spans, is approximately $60 per ft of roadway.

The existing bascule bridge is a simple 56-ft deck-girder span lifted by two counterweighted girders turning on trunnions. As the lifting girders and counterweight frames extend above the proposed roadway with only 16-ft horizontal clearance, it was necessary to lower them approximately 6 ft so that they would be below floor level, and then remove a portion of the counterweight to provide a 21-ft 4-in. clearance. The girder span, which was left in place while the lifting girders were being lowered, was widened by adding an outside line of stringers supported by brackets. An open steel-grid floor was used for the roadway deck. Additional counterweight, mostly lead, was added at the lower end of the lifting girders. The span, previously hand-operated, is now opened with a gasoline engine. The cost of all reconstruction is less than $24,000.

On the existing swing span—a 256-ft through-truss with 14-ft horizontal clearance—spreading of the trusses was the only practical way to obtain a two-lane roadway.

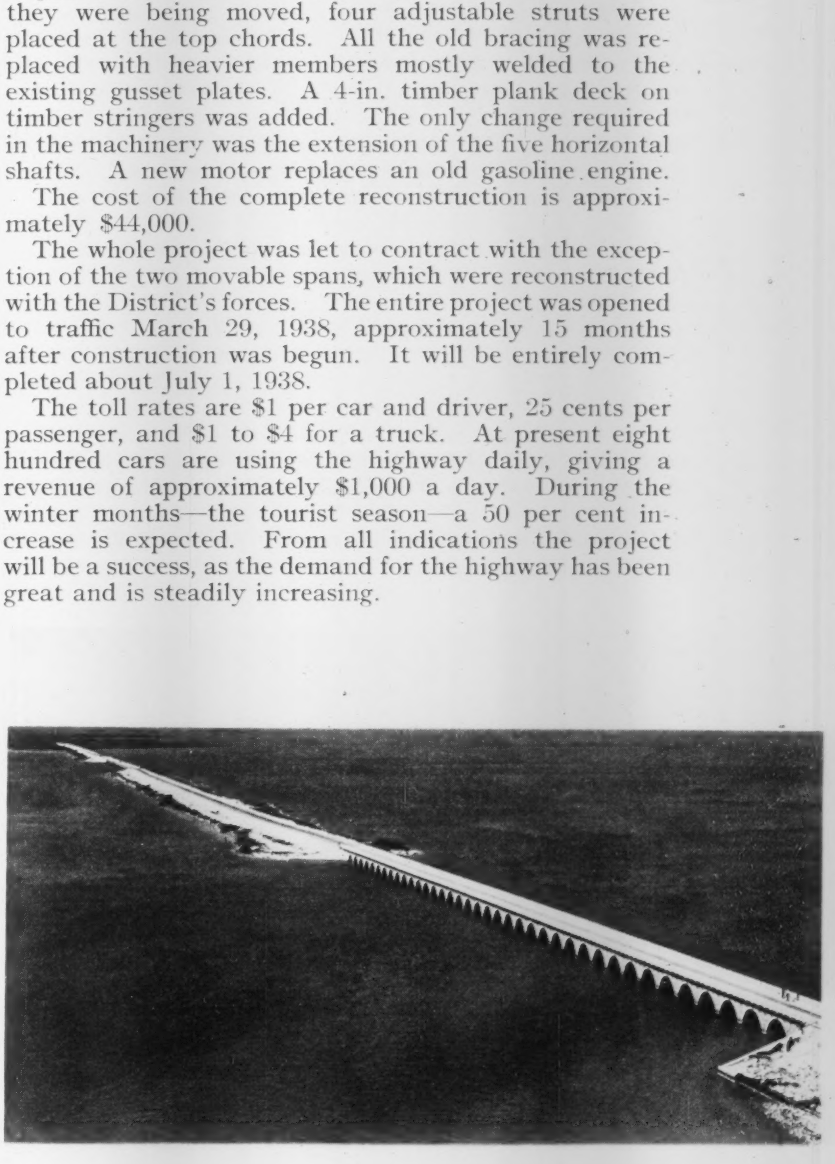
Brackets to support the four center posts in their new positions were added to the drum with diagonal tension ties and compression struts. The span, swung in the open position, was supported on falsework on the center piers of the fender system. The bracing and one side of the floor beams were cut and then each truss was jacked out 4 ft on railroad rails at the panel points.

The existing floor beams were lengthened by splicing in two new sections so that the existing stringers and the end wedge machinery would remain on the center line. This allowed the center section of the bridge to act as a counter balance for one truss while the other truss was moved out, which simplified the jacking operations and required fewer ties. To hold the trusses vertical while they were being moved, four adjustable struts were placed at the top chords. All the old bracing was replaced with heavier members mostly welded to the existing gusset plates. A 4-in. timber plank deck on timber stringers was added. The only change required in the machinery was the extension of the five horizontal shafts. A new motor replaces an old gasoline engine.

The cost of the complete reconstruction is approximately $44,000.

The whole project was let to contract with the exception of the two movable spans, which were reconstructed with the District's forces. The entire project was opened to traffic March 29, 1938, approximately 15 months after construction was begun. It will be entirely completed about July 1, 1938.

The toll rates are $1 per car and driver, 25 cents per passenger, and $1 to $4 for a truck. At present eight hundred cars are using the highway daily, giving a revenue of approximately $1,000 a day. During the winter months—the tourist season—a 50 per cent increase is expected. From all indications the project will be a success, as the demand for the highway has been great and is steadily increasing.



ONE OF THE CONCRETE ARCH SECTIONS
The Overhanging Slabs Are "Hinged" to Provide Protection Against Wave Impact

The Civil Engineer and Malaria Control

Emphasizing the Economics of the Problem and Outlining the Obligations of the Profession

By L. M. Clarkson

Director of Sanitary Engineering, Georgia State Department of Public Health, Atlanta, Ga.

Although the responsibility for curing individuals suffering from malaria falls on the medical profession, the responsibility for general prevention and control measures falls on the engineer. In their manifold construction activities engineers should beware of creating new breeding places for the malaria mosquito, which annually causes losses that must be reckoned in millions of dollars. This article is an abridgment of a paper presented by Mr. Clarkson before the Sanitary Engineering Division at the 1938 Spring Meeting.

The importance of malaria in the United States is quickly shown by reference to vital statistics. In some parts of the country the death rate from this disease is at least three times greater than that from typhoid fever, and the economic loss many times greater. The civil engineer has here an opportunity to render a valuable service to public health, for malaria control is essentially a civil engineering problem.

It is not true that malaria is found only in the South. Although at present it is of serious concern chiefly in that region, it has been and can again be of national importance. Locally it takes precedence over other health problems with which the engineer seems more concerned. Let us analyze it nationally. In the year 1915 in a New England state there were 112 deaths from malaria, and a fatality rate of 5.4 per cent. During a five-year period ending in 1916 a borough of greater New York had a mortality rate of 6.3 per 100,000. Evidence of recent malaria in New England is contained in a report of the State Board of Health of Connecticut of 1914. I quote, "Greenwich has been one of the principal sufferers and in 1912 the number of cases was estimated at about 900." A 1925 report of the Division of Sanitary Engineering of Illinois shows that in 1924 there were 80 deaths from malaria in the state. In 1916 it was estimated that in California there were 25,000 cases of malaria with a localized death rate as high as 13.8 per 100,000. In 1929 there were 603 deaths from malaria in the state of Georgia, with an estimated 150,000 to 250,000 cases. In 1935 in New Jersey there were 155 cases and 6 deaths from malaria. Malaria is a serious public health menace in the South today, and is potentially a national menace.

SOME ECONOMICS OF MALARIA AND ITS CONTROL

It is recognized that the engineer by reason of his profession is concerned, first, with the economic aspects, and second, with the feasibility of engineering construction. Let us then consider the ecnomics of malaria control work.

Some few years ago it was estimated that in the southern states alone 3,000,000 people were suffering with malaria, with a yearly death toll of 15,000 persons, involving an economic loss of $100,000,000 annually. I cannot speak for the accuracy of such estimates, but they are at least indicative of the situation. I am convinced that the annual economic loss in some southern states is in millions of dollars. I quote from an eminent authority formerly connected with the U. S. Public Health Service: "For the South as a whole it is safe to say that typhoid fever, dysentery, pellagra, and tuberculosis, all together, are not as important as malaria."

In an economic survey of two counties in one state it was estimated that in one county the economic loss was $3 per acre under cultivation, and in the other it was about one-third of the annual assessed county tax. Similar financial losses have been found in industrial plants. The managers of the cotton mills in a southern town reported a loss of employee efficiency of from 40 to 60 per cent during four malaria months. Instances can be cited where industries were forced to close down on account of malaria. In some of the larger industrial corporations operating in the American tropics, one-half of the hospital cases are due to malaria. Those companies whose sanitary engineers have practiced malaria control have greatly profited thereby.

In a report of the United Fruit Company, a camp manager stated: "By means of malaria control and sanitation we have obtained more working days per man, more stability, less sickness in camp, and in a three-year period the average increase of earning per man-month has been from $30.79 to $40.80." This is practically a 33 per cent increase in labor output. The loss in an irrigation district in one state in 1918 averaged $31.70 per family. In another county in the Southeast, in a rural area of 25 sq miles, the annual economic loss amounted to more than $12 per acre under cultivation. One large sawmill and box factory in the South stated that minor drainage operations near its plant in 1915 and 1916 were worth $35,000 per year to the company. An anti-malaria campaign in another southern state made it possible for a lumber company to ship 20 per cent more lumber, and increased the revenue to the railroad company by $30,000 a year.

To some the term, "man-made malaria," may seem in need of clarification. Yet much malaria is man-made and is caused by work over which the engineer has control. Not only is the engineer essential in carrying out a program of malaria control but also he may himself cause serious malaria problems if his knowledge of malaria engineering is limited. Young engineers especially should be properly trained in this field. The engineering college should teach them how to avoid becoming allies of the mosquito.

THE SOURCES OF "MAN-MADE MALARIA"

Most engineering construction involves the moving of earth, and therein lies the danger. The undrained borrow pit, for instance, may later develop into a prolific breeding place for the malaria mosquito. This constitutes "man-made malaria." All such borrow pits should be left self-draining or connected in series and completely drained. This can be provided for in original plans and specifications. In some regions, if earth is borrowed without regard for drainage, malaria epidemics may eventually occur. It may then be necessary to resort to costly filling, chemical dusting, or oiling.

There are various other sources of "man-made malaria," such as culvert pipes along railroads and highways placed too high to convey residual water; pits from which clay is obtained for brick making; excavations to obtain water for construction purposes; and other similar sources. It may not be amiss to advise the architect and the landscape gardener to beware of constructing fish or lily pools for urbanites, especially without provision for frequent draining. Those of us with experience have seen malaria caused by such man-made breeding places.

Likewise the hydroelectric engineer should be wary lest in creating power to turn the wheels of industry he jeopardize industry itself by creating a public health menace. Before designing a hydroelectric development, the engineer should consult a sanitary engineer of the state health department. There is absolutely no conflict between public health and hydroelectric development—both should work together for the common good. We of the state health departments can serve a dual purpose, by protecting the public health and at the same time protecting the hydroelectric engineer and the power company from the legal difficulties that may follow the creating of an unhealthful environment. Nearly all state health departments in areas where malaria is prevalent promulgate and enforce, through their divisions of sanitary engineering, regulations for the impounding of waters. The big power companies know that these regulations have been a commercial asset, and the rural public knows that they have afforded health protection.

It frequently becomes the responsibility of the engineer to select a camp site, and the selection of even a temporary one is most important. In some cases he must decide whether it is more economical and satisfactory to choose a site where malaria-mosquito control must be practiced or to select one beyond the mosquito's flight range. If he is not competent to make such a decision himself, he should consult the county or state health department. In the past few years certain CCC camps have been improperly located, without advice from the state health department. The result was malaria and the necessity of moving to new locations at considerable expense. Many contractors, too, have lost money because of unwise locations of camp sites. Furthermore it is always advisable to know that there are no human malaria carriers in such camps. The engineer must consider all phases of protection against malaria at his camp.

Connected with the subject of camps is the subject of malaria in time of war. An editorial in the March 1938 issue of *The American Journal of Public Health*, entitled "Sanitation in the Next War," describes the unpreparedness of the country as regards public health. Should we be compelled to mobilize a large army within a few months it would be necessary to select cantonment sites and protect soldiers against certain diseases. Among other items, it anticipates the need for sanitarians for "the elimination of insect carriers of disease." It emphasizes the need for adequate sanitation personnel in the regular Army and in the National Guard.

Another authority on the malaria problem shows that the maximum malaria infection rate for admissions in the U. S. Army during the Spanish American War (1898) was 694.64 per 1,000 men. This of course slightly antedates the discoveries regarding malaria transmission and control. U. S. Army reports covering a five-year period ending in 1915 show an admission rate for malaria among officers of 19.12 per 1,000 men, against a comparative rate for typhoid of only 0.23 per 1,000. Evidently the first effective malaria-control operations were initiated at the inception of the World War. It is commendable that in the large Army cantonments, even in malarious regions, infection was kept to a minimum. The methods employed were chiefly drainage by Army civil and sanitary engineers.

If we have another war, great numbers of young engineers will be called upon to protect the Army against the danger of malaria. Malaria engineering then will be in great demand just as will other specialities in public health engineering. We must be ready in order to meet this demand.

A Typical Mosquito-Breeding Area

MALARIA CHIEFLY A CIVIL ENGINEERING PROBLEM

Malaria prevention and control has two phases: (1) studies and investigations, and (2) the application of prevention and control methods. The first phase generally concerns epidemiologists, entomologists, and biologists, and the second phase concerns doctors and engineers. However, medicine is more concerned with curing patients, whereas engineering involves strictly prevention and control. The following phases of malaria control concern the civil engineer:

Preparation of urban and rural basic maps for perspective purposes

Drainage work—including plans, profiles, and specifications, and construction supervision

Elimination or treatment of undrained borrow pits

Construction of culverts and concrete aprons, and correction of grades and elevations

Proper design and operation of reservoirs for hydroelectric or other uses

Drainage of clay pits and other excavations

Design and operation of irrigation projects

Correction of faulty street and roadside ditches

Installation of concrete-lined ditches

Catch-basin design

Filling of ponds

Street extension work

Ditch maintenance

Application of oil, paris green, and other larvicides

Housing, screening, mosquito proofing

Location and maintenance of construction and other camps

Design and construction of fish and aquatic pools on urban properties

It behooves the civil engineering profession to recognize its possibilities and its obligations in the field of public health engineering. It is self-evident that public health engineers cannot adequately cover this subject at conferences. Standard study material in the hands of qualified instructors is necessary. Malaria engineering should be included in the curricula of all engineering colleges.

Importance of the Highway Industry in Nation's Economy

By CHARLES M. UPHAM

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ENGINEER-DIRECTOR, AMERICAN ROAD BUILDERS' ASSOCIATION, WASHINGTON, D.C.

DIRECTLY or indirectly, one out of every seven persons gainfully employed in the United States is connected with some phase of highway transportation. Mr. Upham begins his article with a brief survey of some of the many indirect contributions of this great industry to the national economy. Then, turning to highway construction itself, he discusses its value as a creator of employment, and concludes by stressing the need for a comprehensive program of development of roads of all types. His full paper, of which this is an abridgment, was presented before the Highway Division on April 21, 1938, at the Spring Meeting of the Society, in Jacksonville, Fla.

IN dealing with this subject, the term "highway industry" has been broadly interpreted, for it would be difficult if not impossible to appraise the economic value of our highways without taking into consideration the many related and dependent industries.

It has been estimated by numerous authorities that highways supply the foundation for about one-seventh of the national economy. Regardless of the accuracy of this estimate, it can be said that perhaps no other industry, per dollar expended, has such a far-reaching and vital influence upon our social and economic structure.

During 1936 highway transportation in all its phases provided employment for one-seventh of all persons gainfully employed in the entire United States. Over 6,000,000 jobs were provided by the highway industry and other allied industries dependent upon our highway transportation system. This figure includes only direct and indirect employment and does not take into consideration the many thousands who are totally dependent upon motor transportation to gain a livelihood, such as traveling salesmen. Highway maintenance alone has become one of our major industries, providing an average monthly employment of 150,000.

HIGHWAYS AS FREIGHT CARRIERS

In 1936 one out of every seven rail-freight carloads carried highway materials or automotive products. The transportation of highway construction materials alone accounted for one out of every 15 freight carloads.

Recent studies show that in 9 representative states 95 per cent of the fruit and vegetable tonnage hauled less than 300 miles was transported by trucks. Practically the entire milk supply of 21 of the country's leading cities, with a total population of over 10,000,000, is furnished via the highway, and more than half the livestock of the country reaches the market by the same route. The magnitude of the trucking industry is perhaps best illustrated by employment figures. Truck operations during 1936 gave employment to 3,102,265 drivers, who operated 4,023,606 vehicles.

In the United States 39.6 per cent of all communities are without railroad service. These communities (with a total population of about 8,000,000) must look to the highway for their only modern means of transportation.

One out of every five retail dollars results from automotive purchases, and more than 465,000 establishments are engaged in automotive sales, service, and for-hire transportation. In 1935, these retail outlets alone gave employment to 412,000 active proprietors and more than 1,000,000 full-time and part-time employees. They did a gross business amounting to $8,264,000 and paid in wages $1,178,000,000. Particular attention is called to the fact that practically all the establishments mentioned are operated by individual proprietors, or "small business men."

During recent years we have witnessed the rapid growth of the tourist business. In fact, this may now be properly classed as the "tourist industry." It has been said that Vermont is largely dependent upon its tourist trade. Minnesota's $90,000,000-a-year tourist business ranks as its third largest industry. In Michigan the tourist or recreational industry occupies second place and represents an annual income to the state of more than $400,000,000.

To greater or less extent, the economy of every state in the nation feels a similar influence. More significant, however, is the fact that this industry a few years hence will undoubtedly assume even greater proportions and will rank among our leading industries.

The highway itself has become one of the most important integral parts of public works, which today have such a great influence upon our national economy. In periods of depression, as well as in normal periods, highway construction looms large as a factor in the stabilization of industry and the creation of employment. Moreover, as the raw materials used in highway construction are found in most localities in large quantities, we can see that the ultimate cost of a highway may largely be accounted for in labor charges, which in turn represent purchasing power.

DISTRIBUTION OF THE HIGHWAY DOLLAR

The economics of the original expenditure and redistribution of the highway dollar has been very forcefully brought out by a study recently made by the U. S. Bureau of Public Roads. Applying the results of this study we find that a $100,000,000 highway program sets in motion forces which soon result in the transaction of business amounting to $315,602,700, a large percentage of which represents wages. In fact, according to the Bureau of Public Roads, 75 to 80 per cent of highway expenditures go directly to labor. A $100,000,000 program would provide an average annual employment, on job-site construction and in industry, of approximately 102,690 persons. For each one of the 37,960 persons employed directly on highway construction projects, approximately 1.71 names of individuals appear on project payrolls. In addition, for each person employed directly on highway jobs, 1.7 persons are employed directly in industries furnishing materials, equipment, supplies, and services.

It is obvious that in so far as employment on a nation-wide scale is concerned, labor at the job site of a road project is of no greater economic significance than labor performed away from the site. Only when the amount of primary and secondary indirect employment is added to the amount of job-site employment can we properly evaluate the importance of highway construction in maintaining employment. Furthermore, the various types of highway construction differ widely in the amounts of direct and indirect labor they entail; thus the choice of type for a given area can easily be adapted to the unemployment situation therein.

NATION'S ROAD NET FAR FROM COMPLETE

In many quarters the view is held that our highway system is substantially completed. A brief reference to the facts will quickly expose the fallacy of that contention. It is true that there are over 3,000,000 miles of highways in the United States. However, a large percentage of this mileage consists of unimproved dirt roads and worn-out or obsolete roads of higher types.

> **Highway Facts**
>
> *Highways are the foundation for one-seventh of the national economy.*
>
> *As much as 80 cents of the highway dollar may go directly back to labor.*
>
> *Federal-aid highways have been not only self-liquidating but revenue-producing projects for the federal government.*
>
> *Almost one million miles of roads of all classes could reasonably be included in a program of construction and reconstruction.*

In 1937 the federal-aid highway system comprised about 227,000 miles. Of this total the bituminous mixes, portland cement concrete, bituminous concrete, bituminous macadam, and other high-type pavements accounted for approximately 125,000 miles. Of the remainder the largest single item was the gravel and stone type, treated and untreated, including approximately 70,000 miles. There were also about 10,000 miles of sand-clay and top soil, treated and untreated; 10,000 miles of graded and drained earth; and some 12,000 miles of ordinary earth. Thus it is seen that approximately 100,000 miles of the entire federal-aid highway system is in greater or less need of being raised to the higher classifications.

The Bureau of Public Roads estimates that the federal-aid system will include 250,000 miles by 1960. According to the Bureau, from 1921 to 1937 there has been an average annual program of 933 miles of low types of sand-clay, top soil, and stabilized earth; 6,000 miles of gravel and stone; 2,710 miles of bituminous macadam; and 4,837 miles of portland cement concrete, bituminous concrete, brick, and so forth. The Bureau estimates that to maintain existing roads, including replacement, and to bring the mileage of the federal-aid system to 250,000 miles reasonably improved by 1960, would require perhaps a slightly higher mileage of construction per year than the average since 1921. Of greater significance, however, would be a shift in the proportion of the various types of construction.

In the sand-clay, top-soil, and stabilized-earth types, such a program calls for an increase of about 150 per cent over the past rate. There would be a reduction of about 25 per cent in the gravel and stone types as compared with the 1921–1937 level. In the bituminous macadam and intermediate-type bituminous mixtures an increase of approximately 75 per cent is estimated. To maintain the present mileage of high-type pavements would require an average program of about 60 per cent of the average since 1921, but to step up the improvement of this type to meet the requirements of 1960 the additional construction necessary would raise the future annual program to an average of 80 per cent of the 1921–1937 annual mileage.

The foregoing pertains to the federal-aid system only and should not be confused with the total primary system—which includes state highways as well as federal-aid highways and presents a much more serious problem. There is immediate need of a comprehensive program for the extension of our primary system, the replacement of highways and bridges no longer fitted for modern traffic, the improvement of secondary or farm-to-market roads, and the progressive construction of a system of motorways (multiple-lane superhighways) to connect large centers of population.

In 1927 there were 293,350 miles of primary highways (including those in the federal-aid system), of which 176,566 were improved and 116,786 miles were unimproved. By 1937 the total mileage on the primary system had increased to 340,160, with 289,103 miles of improved roads, leaving 51,057 miles untouched. In the meantime, nearly 100,000 miles on this system have become obsolete, thus making a total construction and reconstruction program of more than 150,000 miles. At the same time, consideration must be given to the fact that, of the existing 289,103 miles of improved primary highways, only 113,695 miles have been hard-surfaced.

At the beginning of 1937 there were 177,504 miles of secondary roads under the state highway departments. Of this total, 2,807 miles had been improved with a high-type surface, 82,677 with a low-type surface, and 92,020 remained untouched. Furthermore, outside the state highway systems there are nearly 2,000,000 miles of unimproved dirt roads on which are located more than 4,000,000 farms. These constitute mainly the so-called "farm-to-market" roads which in most instances act as feeders into the primary or secondary system. Recent studies indicate that there is immediate need and justification for the improvement of 700,000 miles of these farm roads.

To summarize, the needed construction and reconstruction program includes 151,057 miles on the primary system, 92,020 miles on the secondary system, and 700,000 miles of farm-to-market roads—a grand total of 943,077 miles.

It is apparent that we must continue our highway program on an adequate basis. Otherwise, in twenty years, obsolescence will seriously threaten the economic progress of our highway transportation system.

HIGHWAYS ARE REVENUE-PRODUCING INVESTMENTS

As compared with other forms of public works, highways occupy an almost unique position in that they actually constitute revenue-producing investments rather than out-of-pocket expense. Practically the entire cost of our vast highway transportation system has been paid for by highway-user taxes, which are largely based on the use of the facilities provided. It follows then, that in addition to providing many economic and social benefits, the construction of highways creates a source of future revenue.

As far as federal funds are involved, highways not only are self-liquidating but show a profit. Since the inauguration of federal-aid in 1917, up to June 1937, the federal government collected through highway-user taxes a total of $2,618,000,000. During this same period, its expenditures for highway construction amounted to only $2,423,000,000. For the single fiscal year 1937—the peak year of federal-aid expenditures—there was a margin of approximately $20,000,000 in favor of the government; and with the steady upward trend in highway use this margin will undoubtedly continue to widen.

Pulp and Paper Industry Moves South

Fourteen New Mills Since 1935; Proper Conservation Will Assure Lasting Supply of Raw Material

UPWARDS of $100,000,000 has been put into the development of the pulp and paper industry in the Southeast in the last two years. Long predominant in the manufacture of kraft paper, that section of the country is now diversifying its output of pulp products, and southern pine is becoming a competitor of northern spruce in supplying the general market for wood cellulose. Various economic aspects of this new trend are considered in the first of these articles, while the second discusses the effects on the forests, and the need for sound conservation measures to perpetuate and improve them. Both papers, here presented in condensed form, were on the program of the 1938 Spring Meeting of the Society.

Recent Developments and Their Significance

By WARREN T. WHITE

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EXPANSION of the pulp and paper industry in the South during the past two years has been nothing short of spectacular. To the casual observer this expansion is only a further manifestation of the trend of industry to seek lower operating costs—but actually it is the result of underlying economic forces which have been in the making for many years. These developments have profound implications for the economic future of this entire section.

The manufacture of sulfate or kraft pulp in the South became a commercial reality more than 25 years ago. Since that time the industry has made consistent progress, and during the past ten years the South has dominated the production of kraft pulp in the United States. The present total capacity of mills in that section is approximately 6,500 tons a day, or more than two million tons annually. In 1936 the United States consumed 2,489,823 tons of sulfate pulp. Of this amount 1,767,764 tons, or 71 per cent, was made in this country. These figures show the relationship of plant capacity in the South to total consumption in the United States and likewise indicate the preeminence of the South in the kraft industry. Taking into account pulp and paper of all kinds, the total requirements of the country now approximate 12½ million tons annually, of which almost half is imported either as pulp or paper.

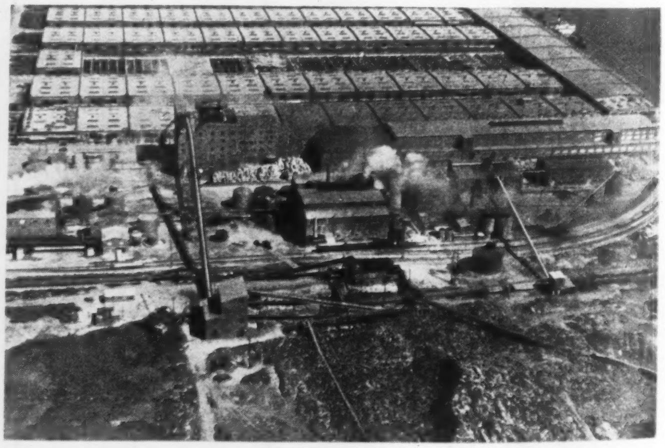
In 1936 and 1937, 13 new kraft mills and one new sulfite pulp mill were established in the South. These new mills represent a total investment of approximately $70,000,000, and their total installed capacity is 3,500 tons a day. Expansions of previously existing mills, improvements in equipment, and investments in timber lands, bring the total expenditures on pulp and paper developments in the South to upwards of $100,000,000 for the two-year period.

The paper industry has grown steadily for one hundred years. In recent years particularly, research has developed wide fields for the use of wood cellulose. The result has been a constantly increasing demand for wood pulp, which by 1936 developed into a world shortage of serious proportions. It was inevitable that the resulting expansion should take place in the South and, to a great extent, along the south Atlantic coast, where the pine belt, from Virginia to Florida, was virtually untouched so far as paper was concerned.

As for production costs, it is well established that the South enjoys a substantial differential below even the nearest competing region. Labor is plentiful, and for sound economic reasons labor costs are lower than in the North, where conditions are less favorable. Moreover, transportation facilities, both by rail and water, afford access to markets at costs which enable the South to compete most effectively with other producing areas.

The South's greatest advantage, however, lies in its abundant supply of cheap pulpwood. Of its more than two hundred million acres of forest lands, the major part is in pine, and the capacity for quick reproduction gives assurance of a perpetual supply. Operating conditions are also favorable, for the climate permits work in the open the year round.

With these prime advantages, prospects are bright for a steady advance in the development of a diversified pulp and paper industry in the South. Heretofore production has been confined to kraft or sulfate pulp, but at present a large mill is nearing completion at Fernandina, Fla., which will produce highly refined sulfite pulp for the rayon industry. In this connection, it is of interest to note that until recently the supply of sulfite pulp has been unable to keep up with the demand for rayon, production of which in the United States has increased since 1924 from 18,000 tons to more than 150,000 tons per year. Increasing demands for wood pulp are also coming from manufacturers of plastics, cellophane, films, lacquers, and kindred products. In



PLANT OF THE WEST VIRGINIA PULP AND PAPER COMPANY AT CHARLESTON, S.C.

fact, wood cellulose is being used in scores of products which form the basis of many of our important industries.

We are already entering the second major phase of the South's development in pulp and paper. Additional sulfite pulp mills will be built to supply the expanding markets just mentioned, as well as for the manufacture of newsprint, book, bond, and magazine papers. While there is as yet no commercial production of newsprint in the South, it is only a matter of a short time before this dream will be realized. A good grade of newsprint can be made from southern pine, and any technical obstacles that remain will be removed through further research and engineering.

The production of pulp is, of course, the first step in the conversion of a raw material into a product that is in itself a basic raw material for scores of consumer products. Pulp and paper mills will be followed by plants to convert the paper and board into bags, packages, and other specialities and by chemical plants and other related industries.

Already we are beginning to see evidence of such a diversification, and of the imprint of the industry upon the business life of the South. In construction alone, many millions are spent for labor and materials; the mills employ thousands of workers in plant operation; and it is estimated that for every employee in the mills, work is provided for two additional employees in direct outside activities of the paper companies. Moreover, the new mills provide markets for trees of pulpwood size, thereby stimulating the practice of sound forestry. We are learning that with proper forest management it is entirely feasible to supply all wood-using industries with their requirements without hurt to any particular one. Our people are now more "forestry minded" than at any other time in history, and a broad conservation program is in the making.

The coming of the pulp and paper industry is a boon to southern agriculture, at a time when national policy calls for the retirement of submarginal lands from ordinary agricultural production. Acres thus retired can be profitably utilized in the growing of timber. Wood cellulose is making marked inroads into markets previously dominated by cotton; but the Southern states do not stand to lose by this substitution, for no matter how far it may go, they will still be in position to supply the markets of the world with cellulose from pine trees. Further benefits accrue to agriculture through absorption of excess farm population in industry.

Within a decade pulp and paper should become a billion-dollar industry in the South. In this great development no group will find greater opportunities for the exercise of talent and ingenuity than the engineers. The science of chemistry blazes trails in creating new products and processes; but it is the job of the engineer to translate these discoveries into a commercial reality. In building construction, in plant design, in the proper arrangement of equipment, it is the engineer who gives practical application to the dreams of the scientist.

Improving the Forest to Meet the New Demand

By Lewis E. Staley

Forest Management Specialist, Florida Forest and Park Service, Tallahassee, Fla.

For nearly one hundred years spruce has been the predominant source of American pulpwood. Recently, however, the fast-growing pine of the South has been challenging the spruce in that field. Out of 68,000,000 acres from Texas to South Carolina, about 60 per cent has been forested in varying degrees of stocking suitable for wood pulp, and the average acre contains around three cords of timber suitable for newsprint and white paper.

Although this is an exceptionally thin crop of wood, it is something on which to build. On well-stocked areas and under adequate fire-prevention and control methods, it is not too much to expect an average acre to produce at least one cord of wood per acre per year with simple forest management.

For many years conservationists and engineers have watched with deep concern the rapid disappearance of our old-growth timber. During the same period, however, considerable effort has been put forth to make the nation aware of the possible danger ahead. Forestry departments have been established in every state where forest lands are of importance, and owners of timber land who a few years ago made little effort to keep fires out of woods or to grow timber on lands best suited to that purpose, are now thoughtfully managing their property for timber production.

In the South we are particularly fortunate in having the natural conditions required for quickly renewing our timber supply, which in many cases has been unwisely handled. Timber can be grown in approximately two-thirds to one-half the time required for growing the same amount of wood in the north. However, Nature alone cannot solve our timber problems; she must be given a chance to do her best, and man must aid her in a common-sense business way.

It seems only natural to think of the South mainly from the standpoint of agriculture. Yet 60 per cent of its land surface is still covered with some form of forest growth. In Florida, there are 23,000,000 acres of land best suited to growing timber, and this large area—roughly two-thirds of the state—is not needed now or in the near future for any other purpose. Particularly during the last fifty years, these forests have been a major source of income to the people of the state. Just how long they will continue to contribute to prosperity will depend largely upon the care and management they are given from now on. All of us should be vitally interested in taking stock now, in definitely determining what we have and what we need, and in seriously planning a timber supply for the future. We must begin at once to practice sustained-yield management on all our timber lands or we will be faced with the possibility of government regulation, which is neither desirable nor necessary except as a last resort. It is a simple matter for timber-land owners to forestall government control by initiating sound conservation practices themselves, and at the same time materially increasing their profits.

An accurate inventory of the forest resources of Florida shows that of the twenty million acres on which commercial forests can be grown, 78 per cent is largely dominated by long-leaf and slash pine, 15 per cent by hardwoods, and 7 per cent by cypress. Most important of all, perhaps, it shows that only 15 per cent of these lands can now be classed as old-growth timber. In other words, during a comparatively short period of intensive lumber production, we have cut over 85 per cent of the forest lands of the state, and through carelessness or indifference have left most of this area in an unsatisfactory condition as regards timber growth. From the details of this survey it is strikingly evident that from now on we must grow nearly all the timber we need for the wood-working industries of the state.

The question of what must be done to perpetuate the pulpwood industry in Florida might be answered in just a few words if we were not interested in perpetuating more than the pulp industry. But we must ask ourselves another question. What should be done about the other wood-products industries that have been a major source of income to Florida up to this time? Shall we give up these profitable businesses for the pulp industry, or shall we consider the pulp industry as an integral part of a comprehensive timber-growing policy?

We now have five mills within the state that will require a continuous supply of pulpwood, and for this discussion we will assume that one more mill will be built. (The Florida Forest and Park Service strongly advises against more than six mills for Florida at the present time.) One of these mills is now manufacturing into pulp approximately 1,100 cords of pine wood each operating day. If it should average 300 operating days per year, it would require 330,000 cords of wood annually. Using the survey figure of one-third cord per acre per year that is being grown on the average acre in Florida at this time, around one million acres would be required to produce the pulpwood for that one mill. Should the six mills eventually operate on the same basis, it would require six million acres to keep them going. This is less than one-third of the total area of forest land in Florida that will grow timber commercially, and about half of the area that is suited to growing pine trees.

But to produce pulpwood alone on the forest lands of Florida, or elsewhere, would be nothing less than a tragedy. Pulpwood is one of the low-value products of the forest. To grow it alone, timber-land owners would be losing millions of dollars annually on their forest-land investment. We must not only provide a continuous supply of pulpwood, but we must maintain the naval stores, lumber, poles, piling, ties, and other wood industries, which have played such an important part in the development of the state up to this time. The pulp and paper mills must be looked on not as sole users of the forest, but as a long-desired "missing link" in profitable timber growing and land utilization.

There are two main jobs that must be done if the forest lands of Florida are to serve the highest purpose and produce the greatest returns for the owners—forest fires must be kept out, and proper selective cutting methods must be practiced.

Fire is the worst enemy of growing timber. In my judgment, forest fires in Florida have destroyed more wood and prevented more trees from growing than the lumbermen have cut. It is not because the forest lands are incapable of producing much more than they are now yielding—but one-third of a cord per acre per year; it is simply that continuous burning of the woods has kept the number of trees down to less than one-third of the number that an average acre should contain. With no fires and fully stocked stands the same areas will grow at least one cord per acre per year, and some areas will greatly exceed that volume.

Next in importance to keeping fires out of the woods is selective cutting. Some lumbermen in Florida have practiced a certain type of selective logging for a number of years. However, their effort could hardly be considered as improving the forests—it was merely a selection of certain kinds of trees to meet market demands as they arose. For this method of operation they should not be criticized too severely. Frequently, the cost of operation permitted taking out only the larger and better trees. In many cases, too, investments were made from the standpoint of early and complete liquidation. This, together with unwise taxation, prevented many lumber companies from cutting their stands selectively and improving the forests. What is needed today is selective cutting of a much higher order, and thanks to improved logging and fire-control methods, there is a real opportunity for it.

SECOND-GROWTH STAND OF SOUTHERN PINE
In the Foreground, Much-Needed Thinning Operations Have Just Been Completed

Pulpwood should be made from thinnings only, especially in stands of long-leaf and slash pine, and from worked-out turpentine trees and waste material from logging operations, as well as from trees too crooked or knotty for first-quality saw logs, poles, or piling. Proper cutting of pulpwood not only returns an income by producing a commodity needed by industry, but also increases the quality of the forest by leaving only the better trees to mature for saw timber and other high-grade products.

Sustained-yield management should be practiced on all timber lands. The maximum volume cut during any period should not exceed the estimated growth during that period, and in forests not up to capacity production the annual cut should remove not more than 80 per cent of the annual growth. Cuts should be made at five- to ten-year intervals in all commercial stands, and not more than 25 to 35 per cent of the merchantable growing stock should be removed in any one cutting. Selection should be made on the basis of relative financial maturity, and no trees should be cut unless they have been marked by a crew working under the supervision of a trained forester.

Conservationists of the South are exercised, and rightly so, by what has been called the menace of the pulp mills. Perhaps the main reason for this concern is that pulp mills utilize trees for pulp and paper that are too small for any other wood products. If all the small trees are cut, the pulp mills will do more harm than good. But it is believed that the southern-pine pulpwood industry is vitally interested in maintaining a continuous supply of its raw material. As evidence in that direction, the pulp-mill owners have established rules for cutting that will go far towards maintaining the supply, and have taken steps to put them in force. It is to be hoped that conservation agencies will do all they can to help the industry in that endeavor.

Runoff of Florida Streams

By DONALD S. WALLACE

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FOR a number of reasons, streams in adjacent drainage basins in Florida may have widely different characteristics of runoff. Lakes and swamps, porous sands and limestones, and large springs all produce effects that make each river essentially a law unto itself. Presented here in abridged form, Mr. Wallace's paper should be of interest to hydrologists in all parts of the country. The full manuscript, including three tables of detailed data, has been filed in the Engineering Societies Library for reference. It was on the program of the Sanitary Engineering Division at the 1938 Spring Meeting of the Society in Jacksonville.

IN considering the runoff of Florida streams, it should be realized first that the related conditions in that state are greatly different from those generally prevailing in the United States. Florida is the most southerly state of the Union, and it possesses a tidal shore line of nearly 2,000 miles, which is 700 miles more than California, the next ranking state in this respect. Topography is relatively flat; the maximum altitude is about 325 ft above mean sea level, and the mean altitude is somewhat below 100 ft. About 55 per cent of the state is less than 50 ft above mean sea level.

Florida is the second largest state east of the Mississippi River but has the least variation in types of underlying rock, being mainly limestone with a mantle of sand, and to a small extent, clay. The Ocala limestone is one of the most important formations in the state. It forms a foundation for the state, and as it is soluble and permeable it has a most important bearing on absorption of rainfall and runoff. Other limestone formations, as the Tampa, which overlie the Ocala in sections, affect runoff in areas where the limestones are present at or near the surface.

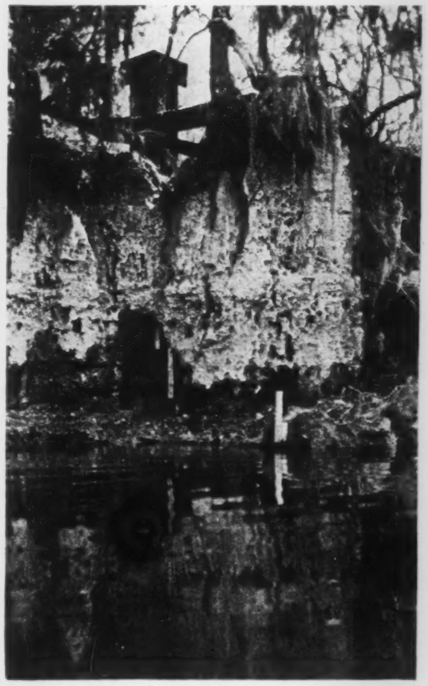
In fact, much of central and northern Florida may be likened to a huge filter bed in a water-treatment plant. The sandy cover, once saturated, transmits the precipitation to the underlying rock almost as fast as a sand filter bed, and passage through this rock to the water table is rapid. Sinks and solution channels are common over much of the central and northern parts of the state; these sinks act as funnels directing rainfall into ground-water storage.

It is this geologic condition which partly explains the fact that surface runoff is relatively low and ground-water runoff relatively high as compared with other parts of the United States. Flat topography is a contributing factor, and in several of the drainage basins there is such an abundance of lakes and swamps that evaporation and natural regulation therein have a large effect on the quantity and distribution of runoff. A good example of this effect of natural regulation and evaporation is the Kissimmee River, which heads in the central part of the peninsula and flows south to Lake Okeechobee.

Another factor that greatly influences runoff is the intensity, quantity, and distribution of precipitation in each stormy period. The temperatures of Florida are semitropical, evaporation from the sandy soil is rapid, and precipitation generally occurs in short periods followed by bright sunny weather. As a result, the sand cover drys quickly and the next rain, if light, merely rewets the top inch or two of soil and is again evaporated with little or no surface runoff and very little ground-water recharge. A half-inch rain, or sometimes even a one-inch rain, if it follows a dry spell, may not have any appreciable effect on runoff; but a 5-in. rain not only replenishes the moisture in the top layer of sand but contributes substantially to ground-water supplies and to runoff through surface streams. It is apparent, therefore, that a considerable percentage of Florida's 53-in. annual rainfall evaporates or is utilized in plant growth and does not become available either for surface or ground water. This explains why runoff is less per square mile than in other states with a smaller total precipitation. It is difficult to give an estimate of this loss other than to say that it may be a surprisingly large percentage of the rainfall.

The major rivers of Florida are shown in Fig. 1, together with the drainage basins in which the smaller streams can conveniently be grouped. It is interesting to note that the formation of the peninsula is such as to have caused the major streams to drain parallel to the north-south axis rather than to take the shortest route to the ocean by draining east and west. The area covered approximately by the northern part of Polk County in the central part of the peninsula serves as a summit, with drainage to the north by way of the St. Johns, Oklawaha, and Withlacoochee rivers and to the south by way of the Kissimmee and Peace rivers. On the west of the summit, minor streams drain westerly. The St. Johns River is quite a curiosity—it heads in marshes and prairies in south Florida and flows 275 miles north to Jacksonville before it turns east to the ocean. Through the whole stretch of its basin the river is but a short distance from the Atlantic, separated from it by only a sand-dune ridge. It is surprising that the short tidal creeks along the Atlantic seaboard have not penetrated inland or that in its early history the upper St. Johns did not cut one or more drainage outlets to the ocean. One must assume, therefore, that in the gradual emergence of the Florida peninsula, the building up of the sand-dune ridge along the coast kept well ahead of the elevation of the land. The Gulf Coast is different; there is no coastal sand ridge and the small coastal streams are much more developed and penetrate inland some distance.

Basins east of and including the Suwannee have something in com-



INTERESTING LIMESTONE FORMATION ON LOWER SUWANNEE RIVER
Recording-Gage Installation in Background

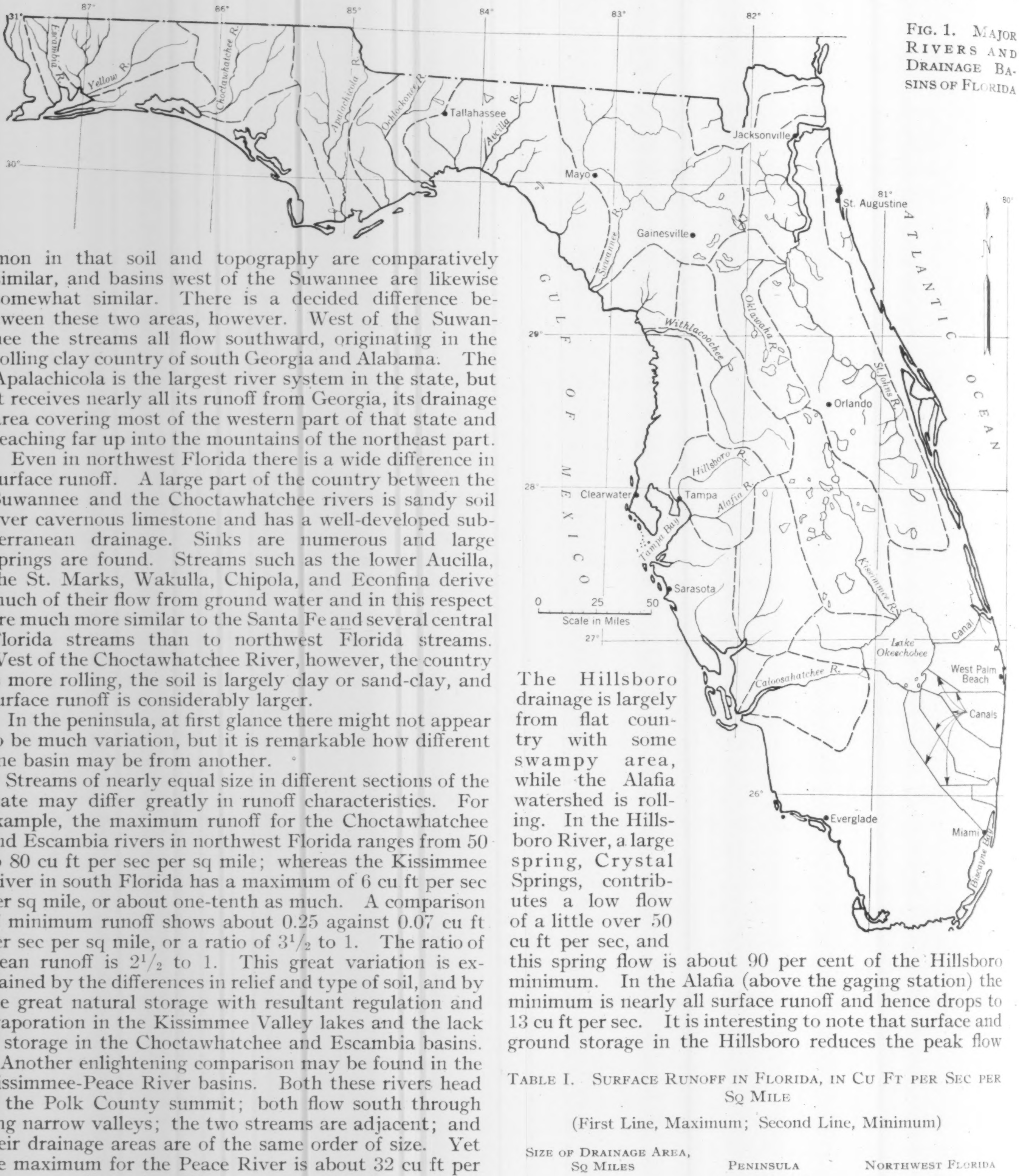


FIG. 1. MAJOR RIVERS AND DRAINAGE BASINS OF FLORIDA

mon in that soil and topography are comparatively similar, and basins west of the Suwannee are likewise somewhat similar. There is a decided difference between these two areas, however. West of the Suwannee the streams all flow southward, originating in the rolling clay country of south Georgia and Alabama. The Apalachicola is the largest river system in the state, but it receives nearly all its runoff from Georgia, its drainage area covering most of the western part of that state and reaching far up into the mountains of the northeast part.

Even in northwest Florida there is a wide difference in surface runoff. A large part of the country between the Suwannee and the Choctawhatchee rivers is sandy soil over cavernous limestone and has a well-developed subterranean drainage. Sinks are numerous and large springs are found. Streams such as the lower Aucilla, the St. Marks, Wakulla, Chipola, and Econfina derive much of their flow from ground water and in this respect are much more similar to the Santa Fe and several central Florida streams than to northwest Florida streams. West of the Choctawhatchee River, however, the country is more rolling, the soil is largely clay or sand-clay, and surface runoff is considerably larger.

In the peninsula, at first glance there might not appear to be much variation, but it is remarkable how different one basin may be from another.

Streams of nearly equal size in different sections of the state may differ greatly in runoff characteristics. For example, the maximum runoff for the Choctawhatchee and Escambia rivers in northwest Florida ranges from 50 to 80 cu ft per sec per sq mile; whereas the Kissimmee River in south Florida has a maximum of 6 cu ft per sec per sq mile, or about one-tenth as much. A comparison of minimum runoff shows about 0.25 against 0.07 cu ft per sec per sq mile, or a ratio of $3^1/_2$ to 1. The ratio of mean runoff is $2^1/_2$ to 1. This great variation is explained by the differences in relief and type of soil, and by the great natural storage with resultant regulation and evaporation in the Kissimmee Valley lakes and the lack of storage in the Choctawhatchee and Escambia basins.

Another enlightening comparison may be found in the Kissimmee-Peace River basins. Both these rivers head in the Polk County summit; both flow south through long narrow valleys; the two streams are adjacent; and their drainage areas are of the same order of size. Yet the maximum for the Peace River is about 32 cu ft per sec per sq mile against Kissimmee River's 3.9—a ratio of 8 to 1. The explanation is the much greater storage capacity in the Kissimmee Valley. For minimum and mean runoff, the ratio is nearly one to one.

In comparing smaller streams, one also finds a great variation. For example, the Hillsboro and Alafia are adjacent, with drainage areas of 525 and 336 sq miles, respectively. Yet their runoff characteristics vary as follows (quantities are in cu ft per sec per sq mile):

	HILLSBORO	ALAFIA	RATIO
Maximum	31.4	89.3	1:3
Minimum	0.114	0.039	3:1
Mean	0.997	0.947	1:1

The Hillsboro drainage is largely from flat country with some swampy area, while the Alafia watershed is rolling. In the Hillsboro River, a large spring, Crystal Springs, contributes a low flow of a little over 50 cu ft per sec, and this spring flow is about 90 per cent of the Hillsboro minimum. In the Alafia (above the gaging station) the minimum is nearly all surface runoff and hence drops to 13 cu ft per sec. It is interesting to note that surface and ground storage in the Hillsboro reduces the peak flow greatly below the Alafia, increases the minimum considerably above the Alafia, and gives about the same mean runoff.

TABLE I. SURFACE RUNOFF IN FLORIDA, IN CU FT PER SEC PER SQ MILE

(First Line, Maximum; Second Line, Minimum)

SIZE OF DRAINAGE AREA, SQ MILES	PENINSULA	NORTHWEST FLORIDA
200 to 500	20 to 90 0 to 0.05	....
500 to 1,000	3 to 35 0.002 to 0.12	....
1,000 to 5,000	3 to 35 0.002 to 0.60	12 to 85
5,000 to 10,000	8 to 12 0.15 to 0.30	....
17,100 (Apalachicola)	....	17.1

Maximum and minimum runoffs for drainage areas of various sizes, based on a study of all available data, are shown in Table I. Mean annual runoff ranges from 0.5 to 1.1 cu ft per sec per sq mile for drainage areas east of and including the Suwannee River, and from 0.9 to 2.0 for larger streams west of the Suwannee. No data are yet available for small streams in northwest Florida.

Florida is famous for its large springs. There are at least 12 discharging 100 cu ft per sec or more, another 12 that discharge from 25 to 100 cu ft per sec, and a large number with a flow of from 25 to 1 cu ft per sec or less. The most renowned spring is Silver Springs, near Ocala, with a maximum flow of about 1,300 cu ft per sec, a minimum of 526, and a mean of 840.

It has been quite a common belief that much of the water emerging in Florida springs comes from far up in Georgia or even from the mountains of the Appalachian system. There is proof to the contrary, and anyone who studies the facts relating to the precipitation, runoff, and geology of Florida must readily see that this flow comes mainly from rainfall within the boundaries of the state.

In studying the runoff of Florida streams, one must be thoroughly familiar with each stream. Otherwise complications between surface and ground-water inflow may lead to erroneous conclusions. It is particularly difficult to make a comparison between streams, or to estimate the flow in one stream for which there are no runoff records, from the runoff records obtained on another stream, even though the conditions affecting flow seem to be very similar. The flow in upper reaches of most of the streams of the peninsula is almost entirely surface runoff, and the flow of some of the small coastal streams is mainly from the same source, but the lower reaches of nearly all the larger streams have great ground-water inflow. The Santa Fe River is a good illustration. Above the gaging station at Worthington Springs the minimum flow (very largely from the surface), is about 1 cu ft per sec. At High Springs, it is about 70 cu ft per sec, while at the station near Ft. White, only 6 or 7 miles further downstream, it is about 670 cu ft per sec, showing a ground-water accretion of 600 cu ft per sec in 6 miles. It is of interest that most of this accretion emerges from the bed of the river rather than from visible springs on either bank. Again, the Oklawaha River above Ocala consists of surface flow, but tremendous ground-water inflow enters through Silver Springs. The runoff per square mile is very small on the upper river, partly because of evaporation from the vast natural storage in the lakes above, and also because there are included in the drainage area many land-locked lakes or areas which do not contribute to surface flow but which do contribute to ground-water flow through subterranean drainage channels leading to Silver Springs. However, even below the junction of Silver Springs with the Oklawaha, the mean annual runoff per square mile is only 13 in., or about 25 per cent of the annual rainfall.

Taking Measurements by Wading, Withlacoochee River

Hillsboro River, Choked with Hyacinths

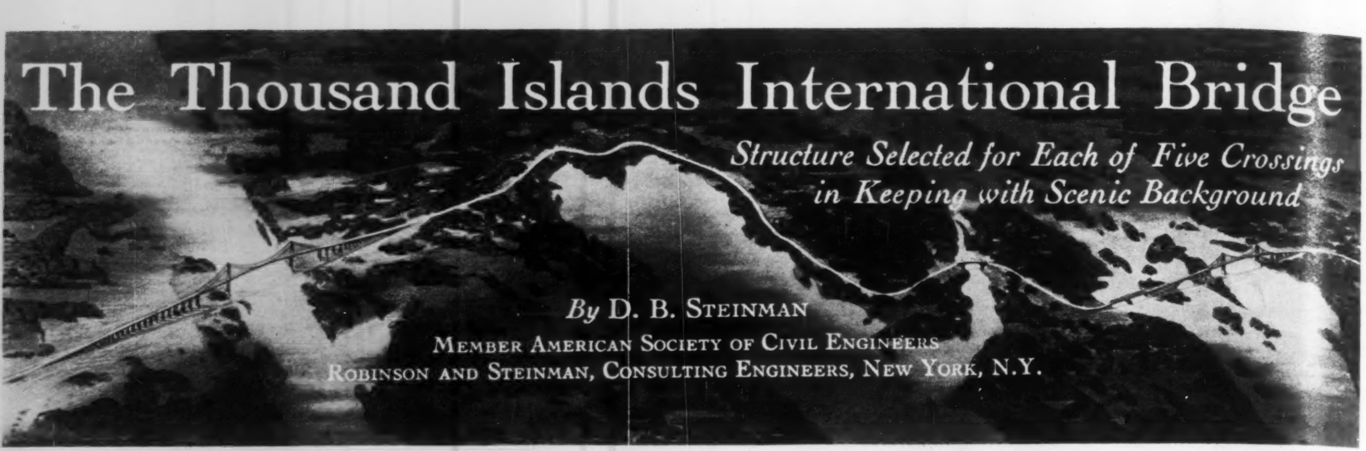
These Plants in Bloom Are a Beautiful Sight, but Constitute a Serious Problem on Many Southern Streams

Of the larger streams in the peninsula, the Kissimmee River and St. Marys River are the only two with little ground-water inflow. West of the Choctawhatchee River the streams consist mainly of surface flow, but most of the streams from the Choctawhatchee to the Suwannee obtain most of their low-water runoff from ground water.

Records in Florida do not extend over a sufficient period of time to permit accurate prediction of either maximum or minimum, but extremely high floods and extreme droughts have occurred during the period 1927 to 1936; and fortunately measurements covering both extremes have been obtained on several streams. Systematic collection of stream-flow records on a state-wide basis was not commenced until 1930, although records on the St. Marys, Suwannee, and Ochlockonee rivers extend back to 1926–1927.

The 1928 flood in north Florida in the area covered by the St. Marys, Suwannee, and Ochlockonee River basins, and the 1926 and 1929 floods in northwest Florida, resulted in the highest known stages in those areas and may represent 100-year maximums. In central and south Florida, the storms accompanying the September 1933 and June 1934 hurricanes caused the highest known stages on some streams and approached previous known maximums on many others. The year 1912, with a total annual precipitation of 65.27 in. for the state average, is the wettest during the period 1891 to date. However, records at Tampa, extending back to 1840, indicate that in 1840 precipitation totaled 89 in. Other record years are 1852 and 1854. Available also are stream-flow records for the droughts of 1931 and 1932, the low runoff of 1933–1935, partial data for 1927, and a few miscellaneous measurements for 1917 and 1921.

The tables included in the extended paper of which this article is an abridgment, present maximum, minimum, and mean runoff data for all gaging stations where it has seemed possible to give, within reasonable limits, the extremes and means either from observed data or from extensions of rating curves. However, it is not the intention of the writer to convey the impression that available data are adequate to solve the problems encountered in the utilization of water in Florida. Particularly on small streams are data urgently needed. On drainage areas of less than 200 sq miles there are no stations with records of more than two years in length. It is imperative that the existing gaging stations be continued in operation and also that a number of new stations be installed. Sometimes a short period will contain record-breaking extremes, as is the case with the period 1926–1936 in Florida, but it is hazardous to base one's calculations on any such short-term records.



The Thousand Islands International Bridge

Structure Selected for Each of Five Crossings in Keeping with Scenic Background

By D. B. Steinman
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An interesting object lesson in artistic and economical design is provided by the series of structures collectively known as the Thousand Islands Bridge. By careful study of the topography, cost has been held to a minimum—but at the same time no pains have been spared to insure that every span will be in harmony with its natural setting. Dr. Steinman here reviews the considerations governing the design of each span, and gives a general description of the project.

THE Thousand Islands International Bridge, now under construction, will join the United States and Canada across the St. Lawrence River. It extends from Collins Landing (near Alexandria Bay) in New York State to Ivy Lea (near Gananoque) in Ontario. This crossing, $8^1/_2$ miles long, utilizes the islands to reduce the span lengths required, so that the total cost of construction is only $2,200,000. The crossing over the American channel, from the mainland to Wells Island, consists of a suspension bridge of 800-ft main span, with an underclearance of 150 ft above the river. The Canadian crossing includes a continuous truss of two 300-ft spans (from Hill Island to Constance Island), a steel arch of 348-ft span (from Constance Island to Georgina Island), and a suspension bridge of 750-ft main span and 120-ft underclearance from Georgina Island to the Ontario mainland. The boundary at the International Rift, between Wells Island and Hill Island, is bridged by a 90-ft rigid-frame arched span of reinforced concrete with masonry facing.

The entire crossing makes an interesting object lesson to the student of bridge engineering. A view of the natural topography and of the exposed rock formations makes the choice of bridge type for each crossing almost obvious. Natural rock abutments rising steeply from the water's edge dictated the steel arch span, and the availability of a small rock island at mid-channel dictated the two-span continuous truss. The discovery of an uncharted shoal of solid rock, surrounded by deep water, 240 ft offshore of Georgina Island, made a 750-ft suspension span economically feasible over the Canadian channel and determined the location and arrangement of the series of spans, piers, and anchorages.

As the Thousand Islands Bridge traverses a region of unusual scenic beauty, it was desired to afford the motoring public a clear and unobstructed view of the colorful panorama from the bridge roadway. This required the use of deck structures in order to minimize obstruction of view by truss members and bracing. High underclearance requirements (150 ft for the American crossing and 120 ft for the Canadian crossing) precluded the use of deck truss bridges of the cantilever or other types. This combination of conditions was best satisfied by the adoption of suspension bridges for the principal spans, with shallow plate girders (only 6 ft deep) for stiffening. The presence of rock at or near the ground surface for inexpensive anchorages further helped to establish the clear economic superiority of the suspension type. In addition, the suspension designs offered maximum grace and beauty to do justice to the scenic setting. Finally, the suspension cables, as the dominant members, are visible bands of steel symbolic of the strong ties of friendship uniting the two nations.

For harmony, deck girder spans were adopted for the approaches. For maximum economy and rigidity, and to keep the girder depth shallow, each viaduct was made a series of three-span continuous girders.

At the crossing between Constance and Georgina islands, immediately south of the Canadian suspension bridge, the roadway elevation was still high enough to permit a deck structure to be used. A simple truss span was first considered, but was changed to a steel arch in consideration of the beauty of the site and the presence of natural rock abutments. A truss span would have contrasted clumsily with the graceful lines of the adjacent suspension bridge.

Further south, in the Canadian crossing, is the bridge between Constance and Hill islands. This is separated from the suspension bridge and the steel arch by the length of plate girder viaduct traversing Constance Island. The roadway level at this point is too low, and the channel is too wide, to permit a deck structure. The availability of a small rock island at mid-channel for a center pier indicated the most economical solution as a continuous through truss of two 300-ft spans.

PIERS AND ANCHORAGES

The south main pier of the Canadian suspension bridge is founded, as previously mentioned, on an isolated shoal of solid rock surrounded by deep water. In addition to reducing the required span length, this pier location made it possible to bring the cable down to economical anchorage within the narrow limits of Georgina Island.

All main piers throughout the crossing, from mainland to mainland, are founded on shallow or exposed bedrock. This favorable condition of topography reduced the cost of the substructure to a minimum. In fact, on this project, the cost ratio of substructure to superstructure is only 1:5 thereby proving an exception to the usual rule that an economical layout is indicated by equal costs of substructure and superstructure.

For the shallow piers, the governing design condition was that of wind on the tower and traveler during tower erection.

The south end of the Canadian suspension bridge lands on the north shore of Georgina Island, while the anchorage is on the south shore. Here the formation of the rock rising steeply from the water's edge is ideal for resistance to horizontal cable pull. It is also ideal for resistance to the horizontal thrust of an arch. Advantage was taken of this fortunate combination of natural conditions to locate at this point a triple-function pier which is unique in design. It serves (1) as the south anchorage of the suspension bridge, (2) as the north abutment of the steel arch, and (3) as the pylon that flanks the north end of the arch to support the arch floor panel and the connecting viaduct span. The favorable conditions of rock foundation for this anchorage permitted a ratio of about 1:1 between net vertical weight and maximum horizontal reaction from arch and cables combined, instead of the usual ratio of 2:1 or 3:1.

For the south anchorage of the American suspension bridge, on the mainland, rock was found to be 30 to 50 ft below the surface. The earth was excavated to a depth of 15 ft, and steel piles (14-in., 89-lb H-beams) were driven over the area of the base. The rear end of this anchorage carries a high concrete pier to support the viaduct spans.

The north anchorages of both suspension bridges are in solid rock close to the ground surface, a favorable condition which reduced their size and cost to a minimum.

To carry the viaduct, which is made up of sets of three-span continuous girders, every third pier is of high concrete construction in order to take the longitudinal reaction and to provide room for expansion rockers; the intermediate piers are flexible steel columns. For such piers as are founded on rock, anchor bolts were run through each pier base and 5 ft into the rock to take care of the temporary uplift reactions producible by wind acting on the structure before the concrete deck is placed. There are no uplift reactions for the finished structure.

A new and improved type of cable anchorage for rope strands, invented by Holton D. Robinson, M. Am. Soc. C.E., of Robinson and Steinman, has had its first application on this project. It is believed to be the simplest and most economical form of anchorage thus far devised for multiple rope-strand cables. Each of the 37 rope strands composing the cable is separately and adjustably connected to a round steel bar projecting from the anchorage concrete. The bars are set in hexagonal configuration to match the strand arrangement, and converge as they project from the anchorage to meet the diverging strands. The upper end of each bar is upset and threaded. Each strand terminates in a cast-steel socket which is externally threaded, opposite hand. Connection and adjustment between strand socket and anchor bar are made by an internally threaded sleeve which is turned by wrench to draw the two together. This arrangement worked smoothly and proved most satisfactory. After adjustment for any length variations, to assure uniform strand tension, the connecting sleeves are spot-welded at the ends to prevent any possibility of subsequent rotation.

DETAILS OF THE FLOOR SYSTEM

The bridge carries a two-lane roadway, 22 ft wide, and two sidewalks. On the suspension spans, the roadway and sidewalks are contained between the stiffening girders, which also serve as railings. Their low height permits motorists to enjoy a clear view of the surrounding scenery. The usual layout of floor beams and stringers is used. The armored concrete roadway has a thickness of $4\frac{1}{4}$ in. and is reinforced with locked I-beam construction. On the viaduct spans it was found most economical to use floor beams spaced about $6\frac{1}{2}$ ft, decked on, and cantilevered beyond, the girders. This arrangement saves steel and facilitates erection; it is also convenient for simple and substantial connection of railing posts. On these spans the roadway is the conventional 8-in. reinforced-concrete slab.

ARCHITECTURAL CONSIDERATIONS

The bridge as a whole is designed with a view to artistic effect in keeping with its scenic background. The dominant features are the suspension-span towers, with the graceful cable curves and roadway lines between them. The tower design is made up of straight lines arranged in pleasing and harmonious composition, with gracefully arched portals above the roadway. The steelwork will be painted a patina green to complete the color harmony of the picture. Each of the four main suspension-span towers is surmounted with two aviation beacon lights.

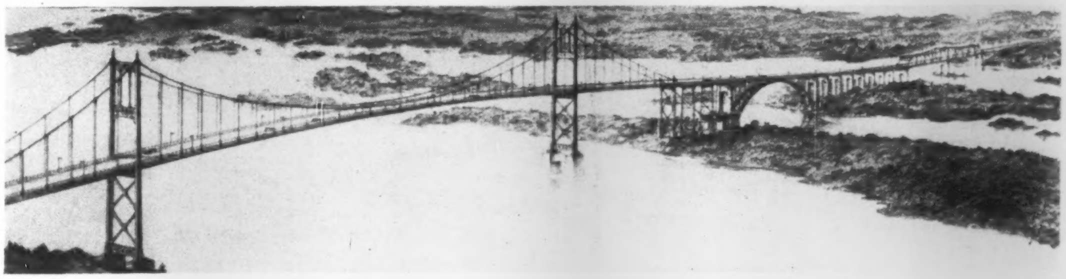
The only international span is the small bridge over the "Rift" between Wells Island (United States) and Hill Island (Canada). With a span length of only 90 ft, this structure has been nicknamed "The Biggest Little Bridge in the World." A brass strip traversing the roadway and bronze tablets mounted on the railings mark the international boundary. A reinforced-concrete span of rigid-frame type, with arch outline, was adopted as economical and appropriate for this structure. It is faced with granite cut from the native rock at the site, so that the arching span uniting the two countries is virtually built of the material from which it springs.

ORGANIZATION AND CONSTRUCTION

The bridge is being built under the auspices of the Thousand Islands Bridge Authority, set up by Act of the Legislature of New York State. To this public authority was transferred the Canadian franchise of a private corporation which had previously been formed in Canada to build the Canadian crossing. The bridge is financed by revenue bonds to be repaid from tolls, and is ultimately to become a free public crossing.

The entire project was designed by Robinson and Steinman, who are engaged as consulting engineers in charge of design and construction. Monsarrat and Pratley, of Montreal, are retained as associate engineers, and William T. Field, M. Am. Soc. C.E., of Watertown, N.Y., is advisory engineer. For Robinson and Steinman, J. London is in charge of the office force on design, and R. Boblow, Assoc. M. Am. Soc. C.E., is in charge of the resident engineer corps on construction.

Construction was commenced May 1, 1937. The contract date for completion is November 1, 1938, but actual completion is now expected in September 1938. As the last border troubles occurred in 1838, the opening ceremonies for the Thousand Islands Bridge are planned to feature the celebration of one hundred years of international peace and good will between the two nations now united by this new link of friendly intercourse.



The Canadian Crossing—Suspension Bridge, Steel Arch, and Two-Span Continuous Truss

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Notes on the Accuracy of Movable-Bed Hydraulic Models

By Joe W. Johnson, Jun. Am. Soc. C.E.

Assistant Hydraulic Engineer, Sedimentation Studies, Soil Conservation Service
U. S. Department of Agriculture, Washington, D.C.

PERHAPS the most important obstacle to a reliable interpretation of movable-bed model studies is the behavior of the bed material. Although the movement of sand under the action of flowing water has been the subject of many laboratory investigations, a satisfactory and general expression for describing its behavior in terms of certain parameters has not as yet been formulated. Even under ideal controlled conditions, as in a laboratory flume, the rate of sand movement may vary from an average by as much as 100 per cent. Naturally then, in models (where conditions may be somewhat less accurately controlled) numerous "repeat tests," under identical operating conditions, are necessary before reliable indications can be derived.

A test on a movable-bed river model usually consists of operating the model through a number of cycles of an operation chart derived from several years of prototype stage records. At the end of the test, the model is drained and cross-sectioned, and a contour map of the bed is prepared. When two such tests are conducted under identical operating conditions, a comparison of the resulting maps by glancing examination usually indicates good general similarity in bed configurations. If, however, a point-by-point comparison of soundings is made, it will be noted that relatively large differences in soundings occur over the model bed. To better illustrate this condition, a comparative map can be prepared showing the difference in soundings at corresponding points selected over the entire bed.

By applying simple statisticale mthods to the results of the point-by-point comparison, a good measure of the accuracy of the model can be obtained. If the sounding differences of each magnitude, with due regard to sign, are counted and tabulated, it will be noted that small differences occur more frequently than large ones. Further, if sounding differences are plotted as abscissae and frequency as ordinates, a symmetrical frequency polygon results (Fig. 1). The symmetry about the position of zero sounding difference is quite striking, and shows, as one would expect, that if the same amount of bed material is introduced at the upper end of the model as is trapped at the tailgate, the amounts of relative scour and fill indicated by the comparative map should be equal to each other.

The possibility of representing the frequency distribution by some single typical figure (an average) at once suggests itself. The commonest type of average is, of course, the arithmetic mean (in this case, the sum of all the individual sounding differences divided by the total number of soundings). The arithmetic mean, however, has little significance unless the degree of variation in the given frequency is known. A common measure of the degree of variation is the "standard deviation," the conventional symbol for which is the Greek letter sigma, σ. The calculated value of the standard deviation as secured from sampling, however, is usually referred to by the letter s; it is determined by the formula,

$$s = \sqrt{\frac{\Sigma fx^2 - \dfrac{(\Sigma fx)^2}{\Sigma f}}{\Sigma f - 1}} \qquad \text{[1]}$$

where f represents the class frequencies and x the sounding differences.

Frequency distributions can be further treated by fitting theoretical curves to the observed data. The "normal curve," for example, is

$$y = \frac{\Sigma f}{s\sqrt{2\pi}}\, e^{-x^2/2s} \qquad \text{[2]}$$

e being the base of the natural system of logarithms and s the standard deviation. In Fig. 1, the normal curve for the observed frequency distribution, as determined by proper substitution in Eq. 2, is also shown.

In a large number of models it has been observed that adjacent to an area where relatively large sounding differences occur as the result of scour, there is generally an area where large differences occur as the result of deposit. That the largest sounding differences are mostly local in character is of importance in interpreting the results of model studies. It has been noted that maximum sounding differences generally occur in pool areas along steep banks and in the vicinity of dikes and other training works. The relatively high degree of turbulence in such regions, combined with the fact that the bed material therein is usually subjected to active movement throughout the complete operating period, probably accounts for this in most instances. When the reliability of a model to duplicate bed configurations is considered, we might, therefore, expect various parts (pool areas and bar areas) of the model bed to possess individual characteristics that are much different from the characteristics of the bed considered as a whole. That is, if the frequency with which sounding differences of various magnitudes occur is determined separately for the areas of the model bed between various bed contours, the frequency curves for the individual areas will show a rather consistent variation

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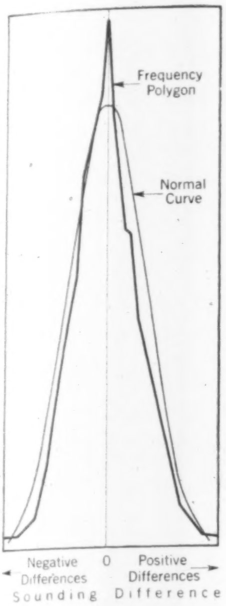

Fig. 1. Typical Distribution of Sounding Differences in Movable-Bed Model

in the degree of "peakedness." The curves for the pool areas show the highest value of the standard deviation, and the curves for the bar areas show the lowest value. In river models the majority of maximum sounding differences do not, as a rule, occur in critical areas such as crossings, but instead in deep pools. To prevent the erratic movement of bed material away from pool areas and the consequent occurrence of large errors, it is common practice in model operation to mold the model bed in the pools with gravel or other resistant material.

Although the writer does not have data available on the behavior of granular material under conditions of highly localized scour, such as that occurring at the downstream toe of an overflow-dam model, it is perhaps reasonable to assume that this type of model would more accurately reproduce bed configurations in two indentical tests than would a movable-bed model of a meandering stream.

Although large sounding differences may be rare, it is of interest to note the manner in which they occur. In a model where the banks are composed of an easily eroded material, slight variations in energy content of the stream and rate of bed-load movement are usually reflected as lateral displacements; whereas, in a model where fixed banks prevent meandering, variations in energy content of the stream are dissipated in bed scouring and are therefore reflected as sounding differences. In the former case large sounding differences in most instances are only apparent, but in the latter case large differences in bed elevation actually occur. Usually, though, it is impractical to mold model banks in the same granular material as that of the bed. Extensive tests on means of supplying cohesion to sand and other materials so that erodible banks can be simulated in models have been only partially successful.

Another obstacle to reliable interpretation of movable-bed model studies is the formation of riffles. Their size and arrangement defy rational explanation, and often make it impossible to secure the same results from two seemingly identical tests. To average the minor irregularities due to riffles, it is a common practice to pass a trowel lightly over the bed surface along each sounding range prior to the taking of soundings. A limited number of tests show that a troweled bed presents a more "peaked" frequency distribution of sounding differences than does an untroweled bed.

The most widely used bed material for movable-bed models is a common commercial grade of sand, which is usually lacking in uniformity of mechanical characteristics. To obtain sufficient tractive force to insure good movement of such material at all stages of flow, it is often necessary to design the models with large-scale distortions and supplementary slopes. The highly riffled bed surfaces formed by the resulting relatively high velocities have naturally proved unreliable for reproducing bed configurations in similar tests. As a consequence, an extensive study of other granular materials has been made by several laboratories. Elaborate tractive-force tests have been conducted on materials covering a wide range in specific gravity and including synthetic sand mixtures, rosin, coal, and pitch.

At the U. S. Waterways Experiment Station, Vicksburg, Miss., sand as a bed material has been replaced by crushed coal. Because of its low specific gravity and relatively large grain size the coal moves in long low waves under feeble velocities. Its use permits models to be designed with small depths and flat slopes and consequently low-scale distortions.

Most models constructed to study the movement of sediment are concerned only with observations on bed load. In fixed-bed models designed to study conditions due mostly to suspended load, "gilsonite" has been used successfully.

Although a model may be adjusted and subjected to "repeat tests" until the engineer is confident of its ability to reproduce bed configurations, it does not necessarily follow that it can be relied upon to predict the action of the prototype. Whether it does or not depends upon the experience of its designer and his familiarity with the prototype itself. Thus, for example, in alluvial streams like the Mississippi River, much of the bar building is perhaps due as much to suspended load as to bed load; but in model and flume studies material moves mostly as bed load—very rarely are velocities great enough to throw material into suspension. Further, in rivers the character of the bed material varies greatly in pool and bar areas, whereas in models it is quite uniform. For the operator not to recognize these conditions—even though he may be unable to reproduce them in the model—seriously limits the value of the results.

Stresses in Continuous Beams from Deflecting Supports

By Odd Albert, Assoc. M. Am. Soc. C.E.

Assistant Professor of Structural Engineering, Newark College of Engineering, Newark, N.J.

Continuous beams supported by girders are usually designed with the assumption that the girders offer fixed supports. It is obvious, however, that these girders will deflect under the loads transmitted to them through these continuous beams. Certain extra moment stresses will therefore develop in the beams, and these moments are usually neglected.

They can be computed by a simple method based upon the various deflections of the free end of a member considered as a cantilever beam, with the reactions from the supports applied as loads, and the influences of other members also considered as loads applied at the ends. Such a reaction (or moment) applied at the free end will tend to bend the free end up or down, depending upon its direction. For example, in Fig. 1, if support *D* of the

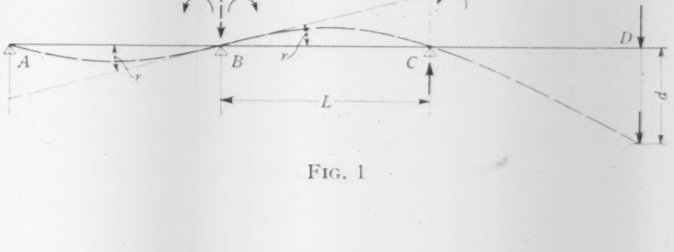

Fig. 1

continuous beam has deflected a distance d, it is evident that this condition can be represented by a negative reaction in D, or a load applied at D equal to this reaction or a moment.

Each beam is cut out and treated separately as a centilever, with first one end and then the other restrained. The degree of restraint is expressed by the deflection angle and the moment at the end in question. Figure 2 shows beam BC cut out, with the moments at the supports, as well as the reaction, applied as loads. In the figure it is considered as a cantilever fixed at B, and the movements of the free end, C, are to be determined.

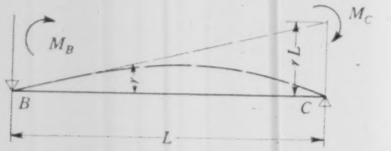

FIG. 2

Attention is called to the fact that the angle r at B is equivalent to an upward movement of rL in C. It will also be noted that this angle is the same as the angle at B for the beam AB, and therefore is equivalent to a downward movement of rL in support A. The outside moment M_C in C will cause this end to move down, while the reaction in C will cause it to move up. Now the sum of all these movements must equal the total movement of support C. (If this support is fixed, then the sum of these movements is equal to zero.) Similarly the beam may be considered as a centilever fixed at C, and the movements of the free end, B, determined.

It is evident that the moments caused by deflecting supports can thus be computed easily, providing the deflections of a fully restrained cantilever beam under various kinds of loadings are known. These deflections are as follows:

For a single load, P, applied at the free end,

$$d = \frac{PL^3}{3EI} \qquad [1]$$

For a moment, M, applied at the free end,

$$d = \frac{ML^2}{2EI} \qquad [2]$$

The following paragraphs are limited to a discussion of continuous beams of equal spans, but the general principle is the same for spans of unequal lengths. Though the moments are derived for movement of one support only for each case, it is easy by addition to arrive at moments caused by the movement of more than one support. The moments are designated by the conventional signs, and the moments from deflecting supports travel from support to support, from minus to plus, or vice versa, along straight lines.

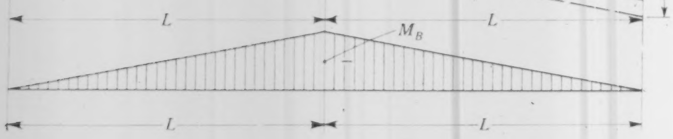

FIG. 3

Two equal spans; support C deflects the distance d (see Fig. 3). Consider beam AB first, and investigate the deflection at A.

As this support is fixed, we know that its total deflection must equal zero. The deflection angle at B is r_1, so the total upward movement will be r_1L. We have a downward reaction in A, causing a downward movement which can be expressed by Eq. 1. Thus we get

$$-\frac{AL^3}{3EI} + r_1L = 0 \qquad [3]$$

and substituting M_B/L for A,

$$r_1 = \frac{M_BL}{3EI} \qquad [4]$$

Consider now beam BC, and investigate the deflection at C, which is known to be d. The deflection angle r_1 causes a downward movement equal to r_1L, and the reaction will also cause a downward movement (Eq. 1). Then

$$-r_1L - \frac{CL^3}{3EI} = -d \qquad [5]$$

and substituting M_B/L for C, and introducing the value of r, from Eq. 4,

$$M_B = -\frac{3dEI}{2L^2} \qquad [6]$$

Two equal spans; support B deflects the distance d (see Fig. 4). As a symmetrical condition exists, only one beam need be considered. Further, the deflection angle at B is zero. Considering beam AB as fixed in B, the deflection in A is upward and positive: and by using Eq. 1 and the fact that $A = M_B/L$, we obtain

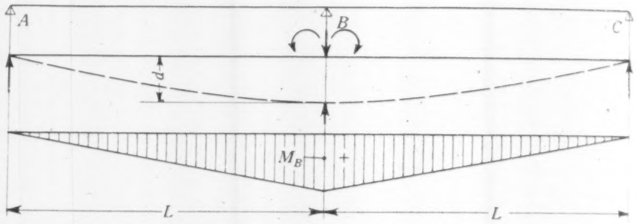

FIG. 4

$$M_B = +\frac{3DEI}{L^2} \qquad [7]$$

Three equal spans; support D deflects the distance d (see Fig. 5). As we know r_1 from Eq. 4, we can start with beam BC, and investigate the deflection in C, that equals zero. We get

$$r_1L + \frac{CL^3}{3EI} - \frac{M_CL^2}{2EI} = 0 \qquad [8]$$

and since $C = \frac{M_B}{L} + \frac{M_C}{L}$,

$$M_B = \frac{M_C}{4} \qquad [9]$$

Considering the deflection in B, which also must equal zero,

$$r_2L + \frac{M_BL^2}{2EI} - \frac{BL^3}{3EI} = 0 \qquad [10]$$

and since $B = \frac{M_B}{L} + \frac{M_C}{L} = \frac{5M_C}{4L}$,

$$r_2 = \frac{7M_CL}{24EI} \qquad [11]$$

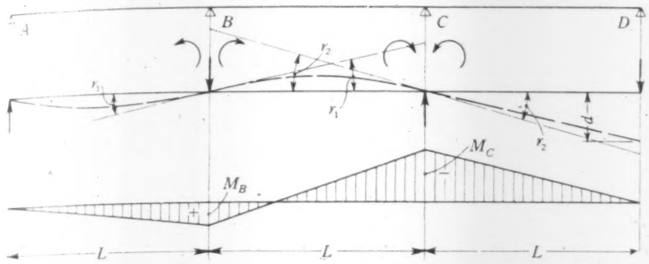

Fig. 5

Consider now beam CD and investigate the deflection in D, which is equal to $-d$. We get

$$-r_2L - \frac{DL^3}{3EI} = -d \qquad [12]$$

and since $D = M_C/L$,

$$M_C = -\frac{8dEI}{5L^2} \qquad [13]$$

Substituting in Eq. 9,

$$M_B = +\frac{2dEI}{5L^2} \qquad [14]$$

Three equal spans; support C deflects the distance d (see Fig. 6). Again we know r_1 from Eq. 4, and can start with beam BC, investigating the deflection in C, which equals $-d$. Following steps similar to those in the preceding cases, we next consider, in turn: (1) BC restrained in C, with an upward deflection of $+d$ in B; and (2) CD, with a deflection of $+d$ in D. As a final result,

$$M_C = +\frac{18dEI}{5L^2} \qquad [15]$$

$$M_B = -\frac{12dEI}{5L^2} \qquad [16]$$

Example. A continuous beam of three equal spans of 10 ft carries a load of 800 lb per running foot. The beam is supported at B and C by two girders, 20 ft long, and at A and D by two non-deflecting supports. Without considering any of the supports to deflect, we determine the size of beam to use. For a moment coefficient of $^1/_{10}$ we find the moment at B or C to be 8,000 lb-ft, and for an allowable steel stress of 18,000 lb per sq in. the required section modulus is 5.33; so we choose a 6-in. 10-lb I-beam, with $I = 17.8$, and $S = 5.9$.

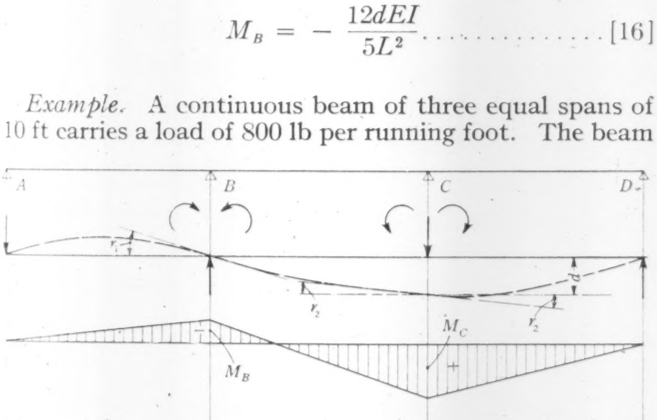

Fig. 6

Now let us determine the effect of the possible deflection of one of the supporting girders—say the one at C. This deflection may be taken as $^1/_{360} \times 20 \times 12$, or $^2/_3$ in., and the corresponding moment in the beam at C is figured from Eq. 15 to be +7,410 lb-ft. The moment at B caused by the same deflection will be, by the use of Eq. 16, 4,950 lb-ft.

It will be seen that the total moment in the beam at support B will be much larger than the design moment—that is, −12,950 lb-ft instead of −8,000 lb-ft, and the total stress in the beam will be $\frac{12{,}960 \times 12}{5.9}$, or 26,200 lb per sq in.

This moment, caused by the deflection of support C, travels to support B, and as it becomes positive, it will decrease the negative moment at support B caused by the loading.

Suggestions on the Maintenance of Steel Windows

By Chester L. Dalzell, Jun. Am. Soc. C.E.

STEEL windows have always been difficult to maintain. So troublesome has been the problem that there is a definite retardation in their use. Though the suggestions made here may not completely solve the problem, they will make the maintenance of steel windows somewhat easier.

It is the experience of the writer that the primary cause of difficulty is the unequal thermal expansion between the steel window and the surrounding masonry. Hence it is important to allow all movement to take place as freely as possible. Steel windows should be bolted to the lintel, and mullions should be embedded in the sill; otherwise the window should be free to move laterally. Obviously, the window must be restrained in a direction perpendicular to its face.

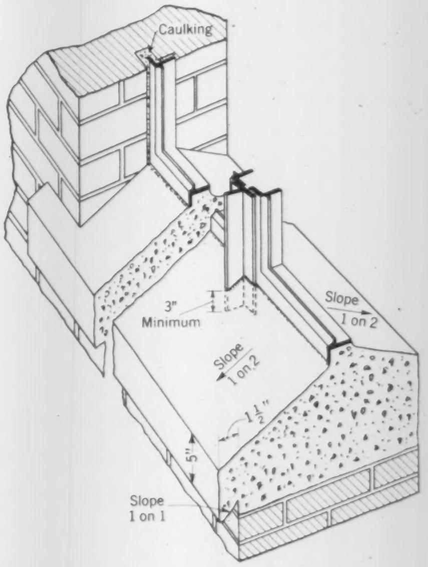

Fig. 1. Isometric Showing Proper Installation of Steel Sash in Masonry

Another source of the difficulty is found in the sill. Common practice is to make the sill with a comparatively flat slope on its top. This results in the collection of ice and snow, with attendant dampness and slow melting. It is important to allow all parts of the metal to drain as rapidly as possible, and a sill with a slope of 1 on 2 or greater will collect little if any ice or snow.

In new installations, the application of these suggestions is comparatively simple. The construction of the lintel is an important detail.

In existing installations, the old window may be removed and replaced, or it can be repaired. If the latter, the proper procedure is as follows: Remove all rusted members (or rusted portions thereof) and replace with new members, welding the whole into one piece as formerly. This generally means that the lower row of lights will be decreased slightly in height, as the rusting usually takes place at the base of the vertical members. The smaller lights in the lower row are not inconvenient and they make it possible to increase the height of the sill. Next, one vertical course of brick around the sides of the window must be removed to break the bond between the window and the masonry. (In a concrete structure it is suggested that a groove about 1 in. deep and 1 in. wide be cut along each side.) When the new sill is cast and the brick replaced, a temporary calking strip of $^1/_8$-in. expansion-joint material should be inserted around the bottom and sides. This effectively prevents reforming the bond. A layer of tarpaper is not sufficient. Finally, the strip should be removed, and the space between the window and the masonry calked with a flexible, asbestos-base calking compound which never completely hardens. In many cases, the source of the difficulty is moisture inside the building. Where this is the case, the process of calking and sill construction as just described should be applied from the inside.

The specification that windows be received unpainted will ensure that they are painted under proper supervision and will prevent damage to paint in transit. It is important that steel windows be thoroughly and well painted before installation and that the painting be repeated regularly thereafter.

With minimum contact between masonry and windows, and with sharply sloping sills and care in painting, much of the difficulty of maintaining steel sash will disappear.

Simplifying Engineering Drawings

By OTTO GOTTSCHALK

CIVIL ENGINEER, VILLA BALLESTER, F.C.C.A. (ARGENTINA)

THE use of inclined dashes on engineering drawings in place of the conventional arrowheads, for dimension lines, ordinates, reactions, and similar details, may prove helpful in clarifying and simplifying the information. The inclined dash is functional in that it tells a complete story. In the fields of statics and mechanics, where it is important to indicate directions of displacements, stresses, inclines, etc., its use has been found especially helpful, the conventional arrowhead being reserved to indicate definite directions only.

Application of the inclined dash and the arrowhead for performing their special functions with maximum clarity is illustrated in Fig. 1. This figure shows a calculation of the deflection of a simple beam AB, the bending moments of which are known. In part (*a*) the linear dimensions are marked with simple inclined dashes distinct from the arrowheads indicating load and reactions. In parts (*b*) and (*d*) the areas of negative and positive reduced bending moments are conveniently divided into triangles and their directions at centers of gravity marked by arrowheads.

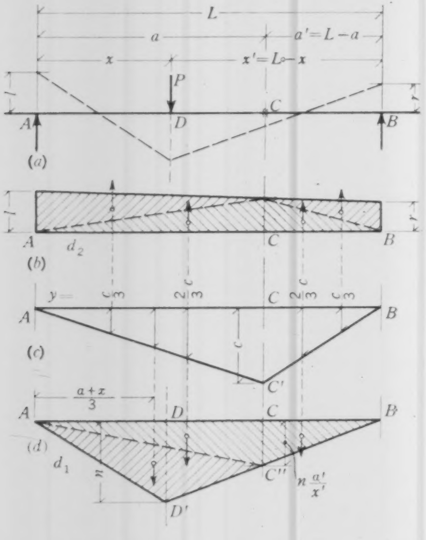

FIG. 1. APPLICATION OF THE INCLINED DASH AND THE CONVENTIONAL ARROWHEAD

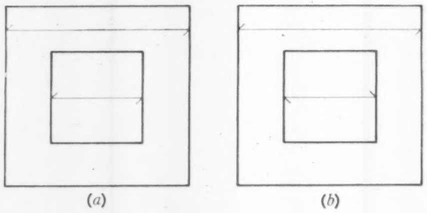

FIG. 2. THE INCLINED DASH INDICATES (*a*) A PROJECTION ON THE LARGER SOLID AND (*b*) A DEPRESSION IN THE LARGER SOLID

In the moment diagram, part (*c*), the ordinate $y = \frac{c}{3}, \frac{2}{3}c$, etc., can be read. These ordinates are indicated by inclined dashes.

Another application of the usefulness of the dash versus the arrowhead is shown in Fig. 2. The dashes in part (*a*) are shown rising from left to right. Thus if the larger dimension line indicates the width of a solid, the smaller line similarly indicates a solid or a projection on the larger solid. In part (*b*) the dashes on the smaller dimension line rise from right to left and therefore indicate an opening in the larger solid. A saving of time, due to the elimination of the necessity for another projection under the old system, is thus accomplished. Clarity and saving of time being two things for which engineers are constantly striving, it is here surmised that those using the simple dash for two weeks will find that it is an effort to return to the arrowhead for showing distances and dimensions.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

City Planning Problems

To the Editor: The article on "The City Plan of Tyler, Texas," by O. H. Koch, M. Am. Soc. C.E., in the April issue of Civil Engineering, calls attention to the great similarity of the problems confronting city planners in all cities, large and small, throughout the country. The haphazard growth of cities, the absence of a skeleton pattern, the jogged and narrow streets, and the lack of thoroughfares are the same everywhere. These factors indicate that at no time have the governing bodies of American cities felt that it was their prerogative or responsibility to prevent the jogging of land subdivisions, to require similarity of street widths in two adjoining additions, or to require that thoroughfares be created as plats were recorded, or that wide streets be placed where there would be the most traffic and narrow streets where traffic would be negligible. Instead, they have simply approved whatever arrangement of platting any land speculator brought in to be recorded.

Mr. Koch has presented an interesting article on replanning a city and one that is worthy of careful study. The basic plan of any city is its thoroughfare plan and boulevard system. In every city, large or small, there must be created thoroughfares which are "elements of transportation," just as a river or a railroad or a trunk highway is an element in the general transportation scheme. The other streets of the city are simply tributaries or feeders.

The preservation, or rather the acquirement of the land along all streams and drainageways, is one of the fundamentals of city planning. As time goes on, not only will these drainageways be found of value in taking care of the drainage of the city, but their presence will also prevent the development of housing in areas which invariably deteriorate before other areas do. Also, because of the advantages of grades such drainageways are the natural routes for highways, the scenery enhancing the development. In fact, any land within a town-site that is not suitable for a first-class, sanitary, residential development should be quickly acquired by the municipality to prevent its being developed for housing. It is one of the unfortunate aspects of planning that we cannot see far enough ahead to definitely locate our parks and playgrounds, but after all drainageways are acquired we are pretty sure of having some of the land that will eventually be required for those purposes.

Old cities are examples of why planning boards and planning are necessary, for planning will not be done except through such agencies. Mr. Koch's reference to railroad relocation is quite pertinent. The shifting of railroad lines is a very difficult matter, for as a rule these lines follow the easiest grades to what is considered the nucleus of the future city. Shifting these lines to another location can only be brought about where increased values in real estate and improved service by the railroad companies will balance the cost of such changes.

George H. Herrold, M. Am. Soc. C.E.
Managing Director and Engineer,
The St. Paul Planning Board

St. Paul, Minn.
April 29, 1938

Limitation of Load on Small Footings

Dear Sir: I should like to comment on the discussion by Paul Andersen, Assoc. M. Am. Soc. C.E., of my article on "The Scientific Method in Earthwork," in the December number of Civil Engineering. In this discussion, which appeared on page 120 of the February issue, reference is made to the limitation of load on small footings (3 ft in least dimension or smaller, according to the proposed Boston code). This limitation is made necessary by the fact that, on cohesionless subsoil, such footings may reach their "ultimate" bearing capcity, with consequent large settlement, at a value less than the "safe" bearing capacity of larger areas resting on the same material.

This behavior is not limited to loose dry sand. The material may be loose or compact, dry or saturated, and may range from rock flour to gravel, as long as it possesses the properties typical of cohesionless soil. Absolute values differ, of course, with different materials, but the general relationship holds.

Glennon Gilboy, Assoc. M. Am. Soc. C.E.
Associate Professor of Soil Mechanics,
Massachusetts Institute of Technology

Cambridge, Mass.
May 5, 1938

The Human Equation in Planned Economy

Dear Sir: I should like to discuss the article entitled "The Balance Wheel" by Allen J. Saville, M. Am. Soc. C.E., in the April issue of Civil Engineering. There is much in the article worth thinking about, particularly at this time when the leaders of the country seem to be groping in the dark. However, there is one factor which seems to me to have been overlooked in the effort to plan the economy of the country and the lives of our citizens—namely, human nature.

I believe that this factor is the explanation for the failure of many of the plans which seemed to be panaceas for our ills. I also believe that it is one of the chief reasons why so-called economists, experts of various kinds, and engineers have missed the mark so widely in their attempts to regiment business and overcome economic laws through governmental aid or coercion.

Heretofore, the economic cycle has been allowed to run its course without much interference. We have had periods of prosperity, followed by inflation and speculation. When credit became too much extended and prices too high, people stopped buying and a forced liquidation followed. When the liquidation had run its course, capital again went to work, business recovered, the country enjoyed another era of prosperity, and the cycle repeated itself. Because human nature is as it is, the world has been going through these cycles since the dawn of history, and it is pretty certain that it will continue to go through them in future ages.

Our attempts at planned economy have ignored the human equation. The economist in Washington said: "We will depreciate the value of the dollar by raising the price of gold, and thus expand the credit base and restore prices and everything will be all right. To fill in the gap while these measures are being put into effect we will spend billions for public works and create prosperity by government borrowing. We will use the credit of the government to accomplish these ends. We will raise the price of cotton and other commodities and start the machinery going; we will raise wages; we will build homes for the workmen . . . ."

They forgot the man who has the money to spend—the human equation. It is the old story of leading the horse to water, but finding that the horse refuses to drink. And from all appearances he is going to continue to refuse to drink until confidence has been restored by a return to basic principles.

When the merchant wants to unload his excess stock of goods, does he raise the price? He does not. He broadens his market by reducing the price and taking a loss, if necessary, in order to cut down his inventory. The lower the price the more goods he can sell. This is so fundamental a principle of business and so fundamental a characteristic of human nature that it seems a platitude to repeat it. Yet this seems to be the very factor that has been overlooked in all the experiments that have been going on in planned economy and planned this and planned that.

Therefore it seems to me that before the engineers can qualify as a balance wheel they should be better acquainted with human nature and give it more weight in their calculations than it has been given in the last five years.

Walter H. Wheeler, M. Am. Soc. C.E.
Designing and Consulting Engineer

Minneapolis, Minn.
April 26, 1938

Comments on Squaring Numbers

DEAR SIR: In his article, "Simplified Squaring of Numbers," in the April issue, Courtney L. Stone, Jun. Am. Soc. C.E., described a method which he has used in squaring numbers not found in the usual tables of squares. The method is both ingenious and useful, since absolutely correct results are obtained with very little effort. The operations performed, though few, are more easily remembered if we understand the mathematical basis of the solution.

Taking Mr. Stone's first example in squaring 122.35, the given number is broken into 122, and 0.35. Then the square will be $y = (a+b^2) = (a^2 + 2ab + b^2)$, where $a = 122$ and $b = 0.35$. A little manipulation avoids squaring 0.35 before adding the terms, thus:

$$y = a^2 + 2b\left(a + \frac{b}{2}\right), \text{ or, } (122)^2 + 0.70\,(122.175).$$

ANTONIO DI LORENZO, Jun. Am. Soc. C.E.

West New York, N.J.
May 2, 1938

Street-Numbering Systems

DEAR SIR: I was particularly interested in an article in the March issue of CIVIL ENGINEERING on "Street-Numbering System for Large Cities" by Richard R. Lyman, M. Am. Soc. C.E., and A. Z. Richards, Jr. My interest was due primarily to an experience that had happened to me just twenty-four hours before reading the article.

First let me state that I am a resident of Queens County, and that some years ago the city fathers saddled us with the so-called Philadelphia system of numbering. For those not familiar with it, I would say that with its aid anyone is supposed to be able to find easily any house from the street address without having to ask for any directions. For a new town being laid out on a prairie the system would no doubt be excellent, but it is not so well adapted to a community like Queens.

To go on with my story, I had been inspecting the new bridges being built in Flushing and was returning home. At the corner of 32d Avenue and 132d Street a motorist stopped me, and asked where he could find 122–1025th Road. He was going in the wrong direction, and had come about half a mile too far. Yet the system of numbering is supposed to make all inquiries superfluous!

My point is that no system, however good, is of any value if a person does not have ordinary common sense, and I think my experience bears out this statement.

KARL W. LEMCKE, Assoc. M. Am. Soc. C.E.

Flushing, N.Y.
May 1, 1938

What Can You Do?

TO THE EDITOR: In his article entitled "Putting the Best Foot Forward," in the March issue, Walter L. Fitzgerald, M. Am. Soc. C.E., points to the need of finding a satisfactory answer to the question, "*How* can a man determine *what* he can do?" My purpose in discussing Mr. Fitzgerald's article is to point out a method, based on sound philosophy and principle, by which one can direct his activities intelligently and logically.

Neither employer nor employee can deal with undefined statements such as "I'll do anything." In dealing with another person, we must have something to present, something to offer, something about which we can negotiate. Let us take the position, therefore, that we will not ask for anything, but that we will offer something. That simple statement is the key to the solution. When you offer something that will yield a profit to the buyer—the employer—you have reversed your position. No longer on the defensive, no longer asking for "anything," you are offering a means to added profits, reduced losses, or increased business.

We have reached the point in employer and employee relations where both need to speak a common language, so that both will know "who can do what." The language must be one that any reader can understand. To quote from A. W. Rahn, author of *Your Work Abilities*, it must be "work language." Trade terms, technical expressions, words not easily understood by the average reader must not be used. This is frequently a stumbling block for the technically trained man. The employee must know what he can do and must define on paper what he can do before he has anything tangible to negotiate about. The employer needs the answer to the question, "Who can do what?" so that he can decide how he can profitably use what is offered. Then both have a common basis for negotiating.

To meet this need and to supply a definition of abilities, Mr. Rahn developed a new science of self-definement, which reveals, defines, and describes the "power of a man." This power is expressed through the medium of a "Man Power Specification." This not only tells who the man is, where he has worked, his schooling, and all the other circumstances that have made him what he is, but also what living has done to him, what it has yielded him in the way of work abilities, and the fields in which those abilities can be profitably used.

A Man Power Specification is drawn up and written by the man himself, following the procedure outlined in Mr. Rahn's book. Considered psychologically, mathematically, or scientifically, this procedure gives the man a tool to work with, defines his power for work, and constitutes an object to lay before his present or prospective employer, so that both can talk about the same thing in the same work language. This transforms either asking for a raise or "job hunting" into a pleasant business transaction, and one does not have to be a psychologist to understand this method and to use it. The Man Power Specification gives a complete and satisfactory answer to Mr. Fitzgerald's question, "What can you do?" With his work abilities defined, the man has something helpful to offer, and in offering it in those places where his abilities may yield a profit to the buyer, he is being helpful. He is offering something in the knowledge that what he has to offer should be of help and interest because he is offering a potentially valuable service in the fields where he knows it can be used.

When a man has thus described in work language the functions he can perform, he has accomplished two results. He has given himself great mental satisfaction because he knows what he can do and where to go to offer his abilities, and he also has an objective statement to lay between the employer and himself so that both are talking about the same thing.

Mr. Rahn has shown the way by which a man can put behind him the heart-breaking task of "looking for a job" and has made available a method which tells *how* to answer the question which Mr. Fitzgerald says must be answered—namely, "What *can* you do?"

CHARLES O'C. SLOANE

New York, N.Y.
May 5, 1938

Aluminum Sheets for Mounting Mosaics

DEAR SIR: The article, "Aluminum Mountings for Aerial Survey Mosaics," appearing in the March issue of CIVIL ENGINEERING, contains several errors. Aluminum sheets were used by this office for mounting mosaics for several projects, but their use has been discontinued due to later discoloration of the photographs. This is probably due to the adhesive used, and attempts are now being made to find a satisfactory adhesive to eliminate this defect.

The 20-gage aluminum sheets 27 by 40 in. originally used were purchased at an average cost of $2.36 per sheet, instead of $1.52, as stated in the article. Further developments showed that the 16-gage unsealed anodic-coated aluminum sheet was the only satisfactory sheet and finish for the construction of controlled mosaics. This type of sheet took pencil and ink satisfactorily, and the prints adhered to it much better than to smooth sheets. The quoted cost of this 27 by 40-in. sheet, cut to a tolerance of plus 0.016 in. and minus 0.000 in., coated, trimmed, and matched to specifications, was $9.75 per sheet. As this cost was considerably greater than the cost of pressboard sheets of the same size, the aluminum sheets of these specifications were not used in any great quantity.

There are advantages to the use of aluminum sheets, and it is hoped that the inherent difficulty in their use can be overcome and a satisfactory permanent mosaic can be laid on aluminum sheets.

RAYMOND G. MOSES
Lieutenant Colonel, Corps of Engineers, U. S. Army; District Engineer

Vicksburg, Miss.
April 29, 1938

SOCIETY AFFAIRS

Official and Semi-Official

Salt Lake City Prepares for Annual Convention

Society to Convene in Utah Capital on July 20 for Four-Day Meeting

On July 20, 1938, the Sixty-Eighth Annual Convention of the Society will open in Salt Lake City, Utah. Featured on the four-day program are a symposium on transportation, technical sessions of the Irrigation, Highway, Surveying and Mapping, and Sanitary Engineering Divisions, and a number of social functions and excursions.

Once again the timing and location of this annual event will provide opportunity for members in all parts of the country to combine attendance at the Convention with a vacation in one of the nation's playgrounds. Special rail transportation arrangements are being made by the Society with this in view.

At the opening session (Wednesday morning, July 20) following the speeches of welcome, President Riggs will deliver the annual address—one of the noteworthy events of every Society Convention. There will also be a brief business meeting. For the afternoon program there is scheduled a series of papers on outstanding developments of the past decade in rail, highway, and air transportation.

On Thursday the Irrigation and Highway Divisions will meet both morning and afternoon, while the Surveying and Mapping and Sanitary Engineering Divisions will have one session each. Barring last-minute changes, the programs will include the following items:

Irrigation Division: Papers on the Deer Creek project, development of the Colorado River system in the upper basin, history of irrigation in Utah, land drainage, and flood control versus conservation; and a progress report of the Committee on Conservation of Water.

Highway Division: Papers on highway planning, state-wide highway planning surveys, highways from the users' standpoint, and flood damage and part played by highways in relief.

Surveying and Mapping Division: Papers on the status of mapping west of the Mississippi River (and especially in Utah and adjoining states), and on air mapping.

Sanitary Engineering Division: Papers on sewage and garbage-disposal needs of the western states, Denver's new sewage-treatment plant, and modern incinerator practice.

Social events will round out the schedule for the first two days, culminating in the dinner and dance on Thursday evening. A dinner and entertainment for members and their guests is also planned for Wednesday. For the ladies there will be sightseeing trips on both days, luncheons, and an afternoon concert.

Utah boasts the world's largest open-cut copper mine—a theater-like quarry at Bingham, almost a square mile in extent. This mine and mill are on the itinerary of Friday's all-day excursion, which will also include a visit to Saltair Beach. Those who wish may remain at the latter place for swimming and evening dinner. The rest of the party will return to Salt Lake City for dinner and an evening visit to the rodeo held in connection with the noted Utah celebration, "Covered-Wagon Days."

Saturday's trips are not yet definitely scheduled, but the local committee is planning a number of them to nearby points of interest. Among these may be mentioned the Pine View Dam, a soil erosion control project near Ogden, and several irrigation projects in operation.

Mention should be made also of the Local Sections Conference, which is to be held on Tuesday, July 19. The conference includes all Local Sections in the Rocky Mountain and Western States.

For the benefit of members in the East and Middle West, a pre-Convention tour has been arranged. The group will leave Chicago for Denver via the Burlington Zephyr on Thursday, July 14, at 5:30 p.m. From Denver they will swing south to Colorado Springs, where trips will be arranged to Pike's Peak, the Garden of the Gods, and other points of interest. On the sixteenth the party will leave Colorado Springs via the Royal Gorge route of the Denver and Rio Grande Western Railroad, arriving in Salt Lake City the following day. For members not involved in committee and Board meetings, local trips will be arranged for the two remaining days before the opening of the Convention.

Arrangements will also be made for optional return routes to accommodate anyone's vacation or travel plans. It is important that those interested in joining the tour group write the Secretary promptly, as space on the streamliner is quite limited.

The official program of the Sixty-Eighth Annual Convention, including a detailed itinerary of the pre-Convention tour, will be published in the July issue of Civil Engineering.

The Famous Temple Square in Salt Lake City
Convention Headquarters Hotel Is Just Beyond the Limits of This Picture, to the Right

The Open-Cut Copper Mines at Bingham
A Point of Interest on One of the Convention Excursions, on Friday, July 22

Local Section Delegates Meet at Jacksonville

Discussion Centers on Economic Status

COINCIDENT with the Spring Meeting of the Society at Jacksonville, Fla., delegates from Local Sections in the Southern Meeting area met in an all-day conference on April 18 to discuss matters of professional interest. While but 12 Sections were officially represented, more than 50 persons were in attendance to participate in the spirited discussions. The prepared program was completed during the morning session, and general discussion continued during the entire afternoon.

Presided over by Director T. E. Stanton, Contact Member of the Society's Committee on Local Sections, the program began with an exposition by John A. Focht, secretary of the Texas Section, of the survey being made by the Texas Section of the engineering organizations in that state. The survey is being made for the purpose of examining the organizations with respect to the qualifications of men required for various types of engineering work, the titles used for them, the duties required, and the compensation paid. It is the hope of the Texas Section that as a result of the survey they may be able to assist engineers in organizations that are out of line to obtain more favorable recognition.

The subject of "What Can the Society and Its Local Sections Do Toward Improving the Economic Status of Young Engineers?" was introduced by H. L. Fruend, president of the Tennessee Valley Section. Taking as a starting point Past-President Hill's challenge that it is necessary for the profession to consider a line of action other than the direct action of collective bargaining and that it is one of the responsibilities of the employing engineer, Mr. Fruend stated that the young engineer will not be satisfied with a solution based on individual responsibility but is looking to the Society as a group for that economic assistance. He recommended that the Society provide an agency through which young engineers can express their difficulties and desires, and receive mature counsel; an agency that can mediate and pass upon specific grievances. Discussion, led by Daniel C. Walser, president of the District of Columbia Section, developed the viewpoint that by reason of their close contact with Student Chapters, Local Sections, backed by the Society itself, are in a position to provide 61 such agencies. A condensation of Mr. Fruend's remarks is to be found elsewhere in this issue.

Considerable attention was given to appropriate methods of encouraging applications for membership by qualified engineers. The subject was introduced by Wilson T. Howe, president of the Virginia Section, and the discussion was led by Roy S. Garrett, president of the Alabama Section. Most Sections have membership committees to interest members of the Society in the work of the Section, but individual members are taking increasing interest in acquainting qualified engineers who are not members of the Society with the opportunity to contribute their energies to the work of the Society. Several Sections are now engaged in making surveys of the eligible engineers in their vicinities. It was brought out that the Society is represented in a given locality by its Local Section there, and that when particularly effective work by a Section is made known, this in itself provides the best incentive for membership.

Harold C. Bird presented many valuable suggestions on Local Section administration from the viewpoint of his long tenure of office as secretary of the North Carolina Section. W. A. Coolidge, president of the Nashville Section, took as his subject the handling of local publicity. "The general conception of civil engineering by the public is quite inaccurate," he said. "Parents of students contemplating the study of engineering have ideas that are vague indeed concerning the work and duties of a civil engineer. The men who preceded us were so busy with their tasks that they overlooked the need of publicizing their profession. How often does the civil engineer on an important civic committee make known the fact that he is a civil engineer?" Mr. Coolidge recommended the appointment by more Sections of local publicity committees and the extended use of the Society's Publicity Manual.

President Riggs, speaking impromptu, said, "The Local Sections are the backbone of this Society. They should be built up to the greatest possible strength." He emphasized the importance of Local Sections' taking steps to encourage Student Chapter members to become Juniors and then to give the Juniors opportunity to serve the profession by active membership on committees and participation in all Society work. He laid stress on the necessity for engineers to take an active part in the affairs of their own communities.

During the afternoon session there was an extended discussion by the representatives of the Sections concerning the proper agency or vehicle through which the Society could improve the economic status of the civil engineer. The conference recorded its unanimous feeling that the improvement of the economic status of the engineer should be made a major objective of the Society; and recommended to the Board of Direction that a Division of Professional Activities be established to accomplish this purpose. These conclusions were presented to the Board of Direction by a committee of the conference during the Jacksonville meeting.

McLoughlin Award Perpetuated

FOR A NUMBER of years the late F. O. X. McLoughlin, M. Am. Soc. C.E., contributed from his own funds an annual prize to the "most deserving student" in the civil engineering department at the College of the City of New York. The award consisted of the initiation fee into the Society. This year the Dam Club, an organization of graduates and graduate students of the college, has perpetuated the custom in honor of Professor McLoughlin.

The recipient of the prize, Frederick Lehman, was chosen from a group of students who participated in a "student paper contest" on March 11. His subject was "The Open Girder or Vierendeel Truss." The papers, given orally, were judged on both content and presentation.

Professor McLoughlin founded the Student Chapter at C.C.N.Y. and was its contact member until his death in 1936. The Dam Club plans to continue the awarding of his prize as an annual event.

Rules for Alfred Noble Prize Modified

THE recommendations of the special committee appointed to review the rules governing the award of the Alfred Noble Prize were adopted by the Board of Direction on April 19, 1938. No drastic changes were involved. The committee specifically stated that it did not think it wise to raise the age limit for the competition, feeling "that the prize should continue as an encouragement to young men."

Hereafter the award is to be made on papers published by the various cooperating societies in the twelve months preceding June 1 of each year, instead of the twelve months preceding July 15, as formerly. The papers are to be in the hands of the Alfred Noble Joint Prize Committee by August 15, and the report of the committee is to be made to the Board by November 1. Continuity in the committee is to be provided by fixing the terms of the members at five years, with one appointment each year.

With these modifications, the rules of the competition stand as stated in the 1938 Year Book. It should be pointed out, however, that in addition to the $500 cash award there mentioned, the recipient is reimbursed from the fund for his necessary expenses for transportation to and from the meeting at which the prize is presented.

The special committee charged with reviewing the rules consisted of Robert Ridgway, chairman, and E. T. Howson, Jesse B. Snow, C. M. Spofford, and Arthur S. Tuttle.

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Meeting of Board of Direction—Secretary's Abstract

April 18, 19, 1938

On the afternoon and evening of April 18, and on the morning and afternoon of April 19, the Board of Direction met at the Hotel George Washington, Jacksonville, Fla., with President Henry E. Riggs in the chair. The following members of the Board and Secretary Seabury were present: Past-President Mead, Vice-Presidents Bellinger, Gowdy, Noyes, and Pirnie; and Directors Agg, Anderson, Ayres, Davis, Dean, DeBerard, Finch, Harrington, Hidinger, Hill, Legaré, Myers, Needles, Proctor, Shea, Stanton, and Tiffany.

Minutes of January 17–18, and January 20, 1938, Board Meetings Approved

With minor revisions, the minutes of the Outgoing Board, January 17–18, 1938, and of the Incoming Board, January 20, 1938, were approved.

Executive Committee

Minutes of the meeting of the Executive Committee, January 20, 1938, were approved as written and the actions ratified. Actions of the Executive Committee at its meeting on April 17, 1938, were approved and adopted as the actions of the Board itself.

Election of Officers

As a regulation procedure at its spring meeting, the Board considered the selection of a Secretary, Treasurer, and Assistant Treasurer of the Society. By unanimous vote the following were reelected for one year:

Secretary, George T. Seabury
Treasurer, Otis E. Hovey
Assistant Treasurer, Ralph R. Rumery

Employment of Engineers and Architects on Public Works

On recommendation of the Committee on Fees, the Board authorized the appointment of a committee of three "to cooperate with the American Institute of Architects and American Engineering Council in the consideration of the employment of engineers and architects on public works."

Publicity

Following the suggestion of the Committee on Public Information, a revised program of publicity was adopted and appropriation made therefor.

Resolution from Junior Association of Colorado Section

There was transmitted to the Board a resolution from the Junior Association of the Colorado Section of the Society urging that the improvement of the economic and social status of the engineer be established as an aim of the Society. The subject matter of this resolution, being similar to the matters now under consideration in terms of a new "Professional Division" of the Society, was referred to the committee having that matter in charge.

Engineers' Economic Status—Division of Professional Activities

These two subjects were further joined in consideration through presentation in person by a committee from the current Local Section Conference, suggesting to the Board the establishment of a Division of Professional Activities and adoption of the subject of improving the economic status of the engineer as a major objective of the Society. After expressing appreciation to the delegation, the Board voted that the subject of the welfare of the engineer is considered of great importance. The Board therefore requested the committee now giving consideration to the proposed new Professional Division of the Society to report at the July meeting a method of procedure and a suitable vehicle for the development of this subject.

Cases of Unprofessional Conduct

The Board concluded its investigation of one case of alleged unprofessional conduct, rendering its decision and directing that the parties concerned be advised thereof.

Hydraulics Division and Research Committees

Various recommendations from the Committee on Technical Procedure were received and acted upon. A new Division, the "Hydraulics Division," was established as requested in petition received last October (as mentioned elsewhere in this issue in more detail). Also the Committee on Research was considered as shortly to be abolished. It is the understanding that the various research committees of which the Research Committee has been administrative, will be allocated appropriately among the Technical Divisions

Arthur E. Morgan

A resolution expressing full confidence in the engineering ability and the personal integrity of Arthur E. Morgan, former Vice-President of the Society and more recently chairman of the Tennessee Valley Authority, was adopted. (This resolution was spread at length in the May issue, page 359.)

Name Changed to Engineering Economics Division

Approval was given to the recommendation of the Executive Committee of the Engineering-Economics and Finance Division, whereby the official name of the Division was changed to the Engineering Economics Division.

Handling Society Investments

Resolutions were adopted making more flexible the procedure whereby the Society may make changes in its investments from time to time.

By-Laws Amended Re Election of Members

Following regulation requirements, including notice at the previous meeting of the Board, the Society By-Laws were amended as to Article I, Sections 1 to 10, inclusive, relating to "Election of Members." The wording of the revised Article I will be found in complete form on another page in this issue.

Rules for Alfred Noble Prize Revised

A report was received from a special committee appointed to suggest desirable changes in the regulations for award of the Alfred Noble Prize. The revised rules were adopted as noted elsewhere in this issue.

THE BOARD OF DIRECTION AT JACKSONVILLE, FLA.

Two Local Sections Authorized

Upon recommendation of the Committee on Local Sections, two new units were authorized as follows: Mohawk-Hudson Section, with headquarters at Albany, N.Y.; and Wyoming Section, with headquarters at Laramie, Wyo.

New Student Chapters

Confirming the recommendation of the Committee on Student Chapters, approval was given for the establishment of Chapters at: The Citadel, Charleston, S.C.; Speed Scientific School, University of Louisville, Ky.; University of Detroit, Detroit, Mich.; and University of Santa Clara, Santa Clara, Calif. Student Chapters now number 119.

Miscellaneous Matters

A number of questions, such as appointment of representatives of the Society, consideration of various committee work, and other routine matters, were considered. In each case action was taken as deemed appropriate.

Adjournment

The Board adjourned to meet in Salt Lake City, Utah, on Monday, July 18, 1938.

Improving the Economic Status of the Young Engineer

Suggestions on What the Society and Its Local Sections Can Do in This Direction; an Abridgment of an Address Presented at the Local Section Conference in Jacksonville, April 18, 1938

By H. L. FRUEND, M. AM. SOC. C.E.,

PRESIDENT, TENNESSEE VALLEY SECTION

THE very form of the question—"What can the Society and its Local Sections do toward improving the economic status of young engineers?"—implies that we have taken the first step in the customary approach to an abstract problem, in that we are agreed that something should be done. The question also implies the joint obligation of "the Society and its Local Sections." We now want to know what can be done, and then will come the third step, "How can we best do it?"

Past-President L. C. Hill in his address last July at Detroit said, "It is imperative that we consider what line of action is available to us other than the direct action of collective bargaining." He emphasized the dual function of employer-employee held by most members and challenged the profession to accept this relationship as an individual responsibility. Individual action has so far failed to withstand the stress of economic necessity during financial storms, and desirable as it may be, it alone never has satisfied our younger members, and it never will.

GROUP ACTION NEEDED

The fact that Juniors now constitute 23 per cent of the total membership of the Society, whereas in 1925 they constituted only 7 per cent, is evidence of the value placed by the young engineer on our traditions and principles. He has faith in our ability as a society, and not just as individual members, to do things for his professional advancement. Let us hope that he never loses that faith through the force of economic necessity.

As Past-President Hill pointed out, there is now under way a concerted effort to form quasi-technical organizations of surveymen, draftsmen, inspectors, and engineering aides. It is with men of this group that the young engineer must start his professional career, hoping by the exercise of skill and diligence to arrive finally at the goal of monetary reward and recognition. If through the force of economic necessity, he feels compelled to join a union of fellow employees, are we unable to offer him any way out more in keeping with the dignity of our profession? From personal observation, I can say that the young member looks to us as a group for the solution of this problem. The question is not one to be laid aside and buried in another committee report.

Ralph L. Lee of the Personnel Division of General Motors gives these six objectives and purposes of each individual worker: (1) an income sufficient to meet his needs and wants; (2) a job capable of providing this income; (3) permanency of employment; (4) satisfactory working conditions; (5) a voice in his own government; and (6) opportunities for advancement. These embody the universal desires of all employees, and may therefore be considered a broad answer to the question of what the young engineer wants.

INDIVIDUAL EFFORT VERSUS COLLECTIVE BARGAINING

We of the older generation were brought up on the doctrine of individual effort, of the necessity for standing on our own feet and fighting our own battles, in the belief that future reward and recognition for hard work would be inevitable. If we now look askance at the tendency toward group action and collective bargaining, let us consider two approved practices of our own Society. In 1914 we adopted a code of ethics, in which we define the principles of professional conduct and of our own relations to each other as members of a society. Is not this a form of group action tending to improve the economic as well as the professional relationship between members? Why not adopt a similar code of ethics for the purpose of defining a better relationship between engineer-employer and engineer-employee? Dr. Robbins of the Harvard Graduate School of Business Administration points out that while we still operate under a profit system, "It is one wherein profit is the result of group action rather than individual effort."

The Society also has a schedule of consulting fees wherein minimum charges are set up for contractual services. Is not this a form of collective bargaining? Is it essentially any different from the schedule of salary classification for engineers of various grades now being formulated in committee? How is this schedule to be put into effect?

NO CONSTITUTIONAL RESTRICTIONS

I want to look backward with you toward the founding of our Society. The first President was elected in 1852. The first annual meeting was held in 1869. The present constitution was adopted in 1921. The purpose of the Society is stated in this constitution as follows: "The objects of the Society shall be the advancement of the sciences of engineering and architecture in their several branches, the professional improvement of its members, the encouragement of intercourse between men of practical science, and the establishment of a central point of reference and union for its members." This is a statement of what the Society can do and wants to do. All the other articles are concerned with methods of administration—that is, with methods of putting this purpose into effect. Nowhere do I find any limitations on what can be done, and I think this is equally true of the By-Laws Our founders were willing to build on a broad foundation and detail their structure as they ascertained its needs.

I suggest that we emulate their example. In the same way that they pioneered 80 years ago in the field of professional improvement, we can now pioneer in the field of human relations. Even as they knew not exactly what was ahead, neither need we know exactly what can be done, provided we are united and agreed that something must be done and are willing to do it.

ESTABLISH A SOCIETY AGENCY

Therefore my answer to the question of what can be done is: Provide some agency through which young engineers can express their desires, transmit their grievances, and receive the benefit of mature advice and counsel; an agency whose major objective is

ANNUAL CONVENTION of the Society, Salt Lake City, Utah, July 20–23, 1938

the improvement of the economic status of young engineers; an agency to mediate and pass upon specific grievances. Industry is now doing this in the field of personnel relations. Can we do this for our own group or is this to be the field of the labor organizer and the union?

That agency must see and understand actual working conditions far from the swivel chair. As engineers, we often act as unbiased agents between owner and contractor. Why should we not do the same between employer and employee?

No one knows what the future will bring. Is anything to be gained by setting up a fence within which whatever action we may take toward the improvement of the economic status of young engineers must be confined, other than that we pledge justice to both sides?

This solution is offered with the hope that thereby we can do something more than talk about improving the economic status of the young engineer; that we can present the example of a united organization willing to approach a specific problem upon a fair basis and consider both sides of the question. As a group we have always done this for the professional welfare of older members, and I see no reason why as a group we cannot likewise do it for the economic welfare of younger members. In this way only can we pass on to them the heritage handed down to us by the founders of our Society.

By-Laws Amended—"Election of Members"

Following prescribed routine, the Society By-Laws were amended by the Board of Direction at its Jacksonville meeting, as regards provision for "Election of Members." The complete Article I, as revised, now reads as follows:

Article I—Election of Members

1. An applicant for admission to the Society in any grade or for transfer from one grade to another shall file with the Secretary a written statement of his training and experience in the form and in such detail as may be prescribed from time to time by the Board of Direction. Each such statement shall include the character and extent of the engineering work on which the applicant has been engaged and the degree to which he was in responsible charge of work and shall distinguish between "responsible charge of work as principal or assistant" and "responsible charge of important work."

The applicant shall state the grade of membership for which he deems himself to be qualified and he shall agree to conform to the requirements of membership if elected. In considering the requirements for the grade of Member the words "responsible charge of important work" shall be interpreted to refer to engineering work of considerable magnitude or of considerable complexity, and the applicant shall state the extent of his responsibility for the conception or design and execution of such important work.

The applicant shall furnish, except as hereinafter provided, the names of at least five Corporate Members to whom he is known personally. Each of these shall be requested by the Secretary to advise the Board of Direction of his personal knowledge of the applicant's character and professional ability and of the grade of membership, if any, for which he deems the applicant to be qualified. No application, except as hereinafter provided, shall be considered by the Board until at least five such references have made definite recommendations based upon personal knowledge.

An applicant for admission to the grade of Junior who is a graduate of a school of engineering of recognized standing, and who is a resident of continental United States or Canada, need not furnish the names of more than two Corporate Members to whom he is known personally. An applicant for admission to the grade of Junior who is not a graduate of a school of engineering of recognized standing may be required to take an oral or written examination under such conditions as the Board may prescribe.

Applicants for any grade who are not residents in continental United States or Canada may furnish the names of two Corporate Members to whom they are known personally, together with a certificate of membership in an engineering society in the country of which they are citizens or subjects or in which they reside, in lieu of furnishing the number of names of Corporate Members otherwise required, provided that the qualifications for membership in said society are deemed comparable to those required for admission to a like grade in the Society.

In addition to the names of Corporate Members to whom the applicant is known personally, each applicant for admission or for transfer shall furnish for each position enumerated in his application the name of an employer or associate who has personal knowledge of his work, or shall explain why any such name is not furnished.

2. The Secretary shall summarize each application when received in proper form and shall transmit a copy thereof to the following:

(*a*) Each member of the Board of Direction for information and voluntary individual classification by those not on the Committee on Membership Qualifications and for preliminary individual classification by those on said Committee. Said copies to the Board shall be grouped each month in a List of Applications.

(*b*) Each Corporate reference, requesting information based on his personal knowledge and for recommendation to the Board as to the grade, if any, for which the applicant is qualified;

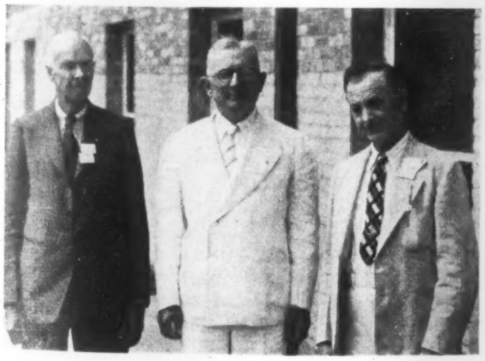
(*c*) Each employer or associate to whom the applicant refers for verification of the applicant's professional record;

(*d*) Each college or university which the applicant attended for verification of his scholastic record; and

(*e*) The Local Membership Committee best situated to investigate the character and professional ability of the applicant for recommendation to the Board as to the grade, if any, for which he is qualified.

There shall also be published in each issue of Civil Engineering a concise abstract of the record of each applicant whose application is in proper form and whose record has not previously been published, and such applications shall be grouped in accordance with the grade for which application is made. Each list shall be accompanied by a request that each member of the Society transmit to the Board of Direction any information as to the ability and character of any applicant known to him.

3. Wherever practicable, the Board of Direction shall establish Local Membership Committees which shall be responsible to the Director of the District in which the Committee is located. In general, each Committee shall consist of three Corporate Members who shall be nominated by the Director and appointed by the Board annually, or when changes are required. It shall be the



Camera Shots from Spring Meeting

At Left: H. J. Morrison, H. D. Mendenhall, and W. W. Fineren—all Members of the Society, and incoming president, treasurer, and secretary of the Florida Engineering Society.

At Right: On Platform at Opening Session—Right to Left, President Riggs, J. A. Long, J. H. Dowling, A. L. Pfau, Jr., and Secretary Seabury.

duty of each Local Membership Committee to investigate and, if practicable, to interview personally each applicant whose record is referred to it, and to report to the Board the result of such investigation and the recommendation of the Committee as to the grade, if any, for which the applicant is qualified.

4. After receipt of information from all of the sources set forth in Section 2 hereof, the Secretary shall classify each application and shall place the name of the applicant on the First Mail Ballot if an Original Clear Case, and if not shall mail to each member of the Committee on Membership Qualifications a Summary of all information received. For convenience, all cases not cleared shall be grouped monthly in a Summary List.

An application shall be classified as an "Original Clear Case," provided that:

(*a*) Applicant's statements as to his professional record are verified;

(*b*) Applicant's statements as to his educational record are verified;

(*c*) No unfavorable information is received as to his ability or character;

(*d*) No member of the Board of Direction or Officer of the Society has requested that the application be referred to the Committee on Membership Qualifications;

(*e*) At least four (except as otherwise provided in Section 1 hereof) and not less than eighty per cent of the Corporate references agree that the applicant is qualified for the grade of membership for which he has applied;

(*f*) The Local Membership Committee to which the application was referred recommends that the applicant be elected to the grade for which he has applied;

(*g*) Not less than four of the Committee on Membership Qualifications upon preliminary classification agree that the applicant is qualified for the grade of membership for which he has applied.

5. It shall be the duty of each member of the Committee on Membership Qualifications to reclassify each application on a Summary List within four weeks of its receipt. In the event that at least four of said Committee and not less than eighty per cent of those voting on such reclassification are in agreement as to the grade for which the applicant is qualified, the Secretary shall place the name of such applicants on the First Mail Ballot, provided that no name shall be placed on said Ballot unless the Local Membership Committee to which the application was referred shall have recommended election to the same or to a higher grade of membership.

6. The Committee on Membership Qualifications, sitting as a committee, immediately prior to the next regular meeting of the Board of Direction shall review all cases not cleared by individual reclassification, together with all cases withdrawn from any ballot or not otherwise disposed of by ballot and any cases referred to it by the Board of Direction. In the event that there is unanimous agreement of the members of the Committee in attendance as to the grade for which an applicant is qualified, provided that at least four are present at the time of voting, the Secretary shall place the name of the applicant on the Second Mail Ballot. All remaining cases except recommendation for declination shall be referred to the Committee of the Whole of the Board of Direction, provided that the Committee may defer action on any application pending further investigation.

7. The Board of Direction, sitting as a Committee of the Whole, shall review all cases referred to it by the Committee on Membership Qualifications and any other case brought to it for consideration at the request of any member of the Board. In the event that two-thirds of the Committee of the Whole are in agreement as to the grade for which the applicant is qualified, the Secretary shall place the name of the applicant on the Third Mail Ballot. In determining the action of the Committee of the Whole a vote for the grade of Member shall be counted as a vote for the grade of Associate Member, or a vote for the grade of Associate Member shall be counted as a vote for the grade of Junior if in either case more than one-third vote to recommend the lower grade. The Committee of the Whole may refer any case back to the Committee on Membership Qualifications for further consideration.

8. All recommendations for declination made by the Committee on Membership Qualifications or by the Committee of the Whole shall be considered by the Board of Direction in session. Three votes to reject any application for admission or transfer shall be final, provided that a rejected application may be amended and reconsidered under conditions prescribed by the Board. In event the Board of Direction does not take action to reject an application, it shall be referred to the Committee on Membership Qualifications for further investigation.

9. Each Mail Ballot shall be in the form prescribed by the Board and shall be of a distinguishing color and the grade of membership for which an applicant is recommended shall be designated. Each ballot shall be canvassed at Society headquarters by tellers consisting of two members of the Board of Direction, who shall certify the results of the ballot, provided that said tellers may refer any case to the Board for certification of election should circumstances so warrant.

The First Mail Ballot shall contain only the names of Original Clear Cases and those cleared by the Committee on Membership Qualifications on reclassification as provided in Section 5 hereof, and shall be canvassed not less than ten weeks after publication of the record of each applicant on the ballot. Any name shall be withdrawn from said ballot on the written request of one Corporate Member of the Society, with a statement of the reasons therefor.

The Second Mail Ballot shall contain only the names of those applicants whose cases were reviewed by the Committee on Membership Qualifications, in session, and shall be canvassed not less than four weeks after said Committee shall have made its recommendation. Any name shall be withdrawn from said ballot on the written requests of two Corporate Members of the Society with statements of the reasons therefor.

The Third Mail Ballot shall contain only the names of applicants whose applications were considered by the Board of Direction sitting as a Committee of the Whole, and shall be canvassed not less than four weeks after the recommendations of said Committee of the Whole are made. A name may not be withdrawn from the Third Mail Ballot.

On any ballot a vote for the grade of Member shall be counted as a vote for the grade of Associate Member, or a vote for the grade of Associate Member shall be counted as a vote for the grade of Junior if in either case more than one-third vote for the lower grade. On any ballot three negative votes shall reject any application for admission or transfer. Any rejected application may be amended and reconsidered under conditions prescribed by the Board.

10. The membership of the Society shall be notified by publication in CIVIL ENGINEERING of all admissions to any grade and of all transfers from any grade to a higher grade of membership. The Board shall not make public its action to reject any application, and notice of the fact of declination only shall be sent the applicant.

All elected candidates shall be duly notified and shall subscribe to the Constitution and By-Laws of the Society. Forms for these purposes shall be prescribed by the Board of Direction. If the candidate does not comply with this provision within six months from the notification of election, such election shall be considered void unless for special reasons the time shall be extended by the Board of Direction. Membership in any grade shall date from the day of election to that grade.

Recent Student Chapter Conferences

THIS SEASON has been especially busy for Student Chapter organizations aside from the usual meetings held by individual Chapters. During April a number of conferences of Student Chapters were held.

VIRGINIA CONFERENCE

On April 9 the Virginia Conference of Student Chapters met at Lexington, Va., with the Chapter at Virginia Military Institute acting as host. It was an all-day program, to which both student delegates and Society members were welcomed by Major General Charles E. Kilbourne, superintendent of the Institute. In the technical session two practicing engineers spoke on certain phases of engineering work in business and industry. This was followed by the presentation of prepared student papers and an open forum on the opportunities now available to young engineers. The afternoon included a military review and gymkhana. After the delegates had banqueted together in the evening, they attended with their ladies the newly instituted "Coronation of the Queen" and the ball in her honor.

SOUTHEASTERN CONFERENCE

The Southeastern Conference selected the time of the Spring Meeting of the Society in Jacksonville on April 20 for its meeting this year, combining it with the numerous meetings and social functions of the Society itself. The conference was fortunate in being addressed by H. E. Riggs, President of the Society, and the technical program included several well-presented student papers. A record distance of travel by those attending was the 1,200 miles recorded on the speedometer of the car piloted by officers of the Student Chapter at Texas Agricultural and Mechanical College. At the business session, two new Chapters were voted into the conference—Tulane University and the University of Florida. The invitation of the Chapter at Georgia School of Technology was accepted for the 1939 conference of the Chapters in this group.

PHILADELPHIA CONFERENCE

At the University of Delaware on April 25, the 11 Student Chapters in the vicinity of Philadelphia convened for the fourth successive year in an all-day conference. To the welcome by Dr. Walter Hullihen, president of the University of Delaware, William H. Chorlton, president of the Philadelphia Section, responded. Two student papers presented in competition were selected for awards by a committee of the Philadelphia Section. The first prize, consisting of the initiation fee and one year's dues as a Junior of the Society, together with $20 in cash, was awarded to A. Clifton Mowbray of Drexel Institute, for his paper, "Placing Two Plate-Girder Spans in Eleven Hours." The second prize, consisting of the initiation fee and the first year's dues only, went to Robert C. Lipman, of the University of Pennsylvania, for his paper, "Extension of Pennsylvania Railroad Electrification—Paoli to Harrisburg." The competition was open to seniors, for papers of about 2,000 words in length, the awards being based 80 per cent on composition and 20 per cent on delivery.

After an informal luncheon in the Old Commons Building, the conference was addressed by Charles Carswell, M. Am. Soc. C.E., who spoke on "The Lincoln Tunnel," which is now under construction under his field direction.

About 200 students and members of the Society attended the conference. This response was partly due to the fact that the participating engineering schools suspended classes for the day to permit attendance at the simultaneous conferences of civil, mechanical, and electrical engineering students.

DISTRICT OF COLUMBIA CONFERENCE

On April 29, the University of Maryland was host to the District of Columbia Conference, meeting for the third successive year. This conference consists of the Student Chapters at Catholic University, George Washington University, Johns Hopkins, and the University of Maryland. Dr. H. C. Byrd, president of the University of Maryland, greeted the delegates and members of the Society. His welcome was responded to by the presidents of the Student Chapters in attendance. Then Julian L. Schley, M. Am. Soc. C.E., Chief of Engineers, U. S. Army, gave a splendid picture of the "Engineering Activities of the Corps of Engineers" in an illustrated lecture. The business session was devoted to considerable discussion concerning the purposes of student conferences and how best to accomplish them. In the afternoon the 80 delegates divided into groups to travel by bus on two separate field inspection trips. In the evening, members of the Maryland and District of Columbia Sections joined the students at the Lord Calvert Inn for dinner, which was presided over by H. H. Allen, M. Am. Soc. C.E. The first All-Engineers Ball given by the College of Engineering of the University of Maryland, followed the dinner. The offer of dancing partners was an added inducement to the delegates to attend.

NORTHEASTERN CONFERENCE

For three successive years the Student Chapters at Cornell, Clarkson, Rensselaer, Syracuse, and Union have enjoyed successful conferences. This year the conference was held on April 30 coincidentally with a meeting of delegates from the six Local Sections in New York, all as guests of Syracuse University. During the morning, students and members joined in an inspection trip to the Ley Creek Disposal Plant, now under construction as an Onondaga County project. For luncheon, places for 80 were set in the College Commons, where Louis Mitchell, M. Am. Soc. C.E., dean of the College of Engineering, welcomed the delegates to Syracuse University. At the afternoon session student papers were presented in competition, and three prizes were awarded. At the business session which followed it was decided to hold the 1939 meeting at Union College. Previous meetings of the conference were held at Cornell in 1936, and at Rensselaer in 1937. In the evening the student delegates joined the members of the Syracuse Section and the visiting representatives from the other New York Sections at a banquet at the Onondaga Hotel. Addresses by A. W. Harrington, Director, and H. E. Riggs, President, Am. Soc. C.E., stressed the desirability of the Local Sections' cooperating with each other and with the Student Chapters in their neighborhood.

NORTH CAROLINA CONFERENCE

Following a plan conceived by the late J. L. Becton, president of the North Carolina Section, the spring meeting of the Section at Pinehurst on April 30 was combined with the annual conference of the Student Chapters at North Carolina State College, Duke University, and the University of North Carolina. Special arrangements were made by the Section for the transportation and entertainment of students. Papers previously selected for prize awards were presented at the Section meeting. At the business session, the conference discussed the advisability of enlarging its scope by inviting Chapters in neighboring states to participate in the next conference to be held.

Hydraulics Division Authorized

THE BOARD of Direction at its meeting in Jacksonville on April 19, 1938, approved the petition for the formation of a Hydraulics Division, the twelfth Technical Division in the Society. This was done upon recommendation of the Committee on Technical Procedure to which the original petition, signed by more than 200 members and presented to the Board last October, had been referred for study and recommendation.

In this petition it was contemplated that the new group should be called the Hydraulic Engineering Division, but the Committee on Technical Procedure recommended the name, Hydraulics Division "as being more descriptive of the new activities expected under it and anticipating that activities now existing in other Divisions will largely be coordinated rather than superseded." The existing activities referred to are of course in the field of hydraulic engineering.

The object of the new Division as stated in the petition is "to strengthen the position of the civil engineer in general and special fields of hydraulic engineering, to sponsor papers and encourage discussion of hydraulic engineering subjects, to urge civil engineering colleges to equip their students in hydraulic engineering with a knowledge equal to that imparted in the curriculum of any other type of engineering college."

Creation of the new Division is largely due to the interest and activities of Fred C. Scobey, M. Am. Soc. C.E., the 1937 chairman of the Society's Committee on Research. An analysis of Society and Division Committees had indicated that 28 committees were concerned with water in one way or another and this index of interest was substantiated by the large number of prominent members of the Society who signed the petition for forming the Division.

As soon as the officers of the new Division are selected, notice will be given in these columns.

Members of the Society in any grade may enroll in the Hydraulics Division upon request to Society Headquarters.

Appointments of Society Representatives

H. G. BALCOM, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Engineering Foundation, his term to commence in October.

VAN TUYL BOUGHTON (chairman), JOHN C. RIEDEL, ROY M. GREEN, NED SAYFORD, RAYMOND A. HILL, OSCAR A. PIPER, and ARTHUR S. DOUGLASS, all Members Am. Soc. C.E., have been appointed to give further consideration to the subject of unionization of the engineering profession.

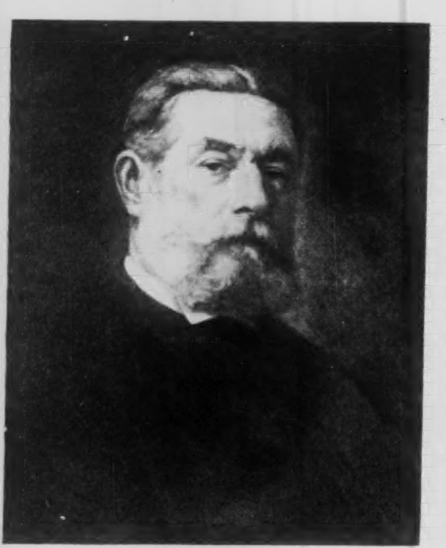
BENJAMIN FRANKLIN, M. Am. Soc. C.E., represented the Society at the ceremonies upon the occasion of the dedication of the Franklin Institute of the State of Pennsylvania, held in Philadelphia.

Early Presidents of the Society

XXVII. BENJAMIN MORGAN HARROD, 1837–1912

President of the Society, 1897

IT WOULD BE difficult to evaluate the individual contributions of Benjamin Morgan Harrod to the profession, for the work of his mature years is largely merged with that of his fellows on the Mississippi River and Panama Canal commissions. Some measure of the esteem in which he was held, however, can be gained from the fact that of the more than fifty men who have served on the Mississippi River Commission since its organization in 1879, only one has surpassed his record of 25 years of membership; and of the seven members of the Isthmian Canal Commission of 1904, he was the only one to be retained in the second commission, under which the work of digging the canal began in earnest.



BENJAMIN MORGAN HARROD
TWENTY-SEVENTH PRESIDENT OF THE SOCIETY

Harrod was born in New Orleans in 1837. He was graduated from Harvard in 1856 and three years later commenced practice as engineer and architect in the city of his birth.

In April 1861 he enlisted as a private in the Confederate Army, and was soon commissioned as lieutenant in an artillery regiment, being detailed on engineer duty. He served as brigade and division engineer with the command of Gen. M. L. Smith in the fortification and defense of New Orleans and Vicksburg. After the surrender of the latter place he was exchanged, and commissioned as captain of engineer troops in Virginia. In that capacity he engaged in the defense of Petersburg and Richmond, and followed the fate of Lee's army to its surrender at Appomattox.

After eight more years in private practice in New Orleans, Harrod was selected in 1877 as chief state engineer of Louisiana. He and his two associates constituted a board whose principal function was to construct a system of protective levees in the alluvial regions of the state. From this post, his appointment as a member of the Mississippi River Commission on its organization in 1879 was a logical step.

The duties of the Commission included (and include) the survey of the Mississippi River and its tributaries from its headwaters to the head of the Passes; the advisory conduct of the work of improving its navigation in the 1,063 river miles below Cairo; and the building of levees. The Commission's plans are subject to the approval of the Chief of Engineers and the Secretary of War, and are executed by the Corps of Engineers. In an address delivered before the Commercial Club of Cincinnati in 1903, Harrod told the story of the first 24 years of its activities.

WORK OF THE MISSISSIPPI RIVER COMMISSION

"The attention of the Commission," he said, "as soon as work was made possible by the beginning of appropriations, was directed to . . . the revetment of banks and the contraction of channel width. For guidance in such work there was much experience on European rivers, a great deal of which had been successful, and a little on Indian and American rivers, which had been almost entirely experimental. The European work, mostly German, had the advantages of a perfect organization and large resources. The work elsewhere was desultory and therefore generally unsatisfactory. But the great difficulty in sight here was the immense magnitude of the Mississippi, of its dimensions and forces, when compared with the Rhine, the Garonne, the Rhone, or other improved alluvial streams. Close under banks of sand or other treacherous material, standing nearly vertical for a height of 40 ft at low water, were pools from 50 to 75 ft deep, through which the flood rushed with a depth of one hundred feet or more, and a velocity of six or seven miles per hour.

"Impressed not only with the magnitude of the work but its great cost, the efforts of the Commission were first directed to experimental constructions with the view of determining how slight a revetment would serve the purpose, and to developing improved methods of constructing and handling the immense mats which were evidently necessary. Two reaches, each about 35 miles long, Plum Point, 60 miles above Memphis, and Lake Providence, 60 miles above Vicksburg, both characterized by a series of bars making the most serious obstructions to navigation between Cairo and Red River, were selected for the inauguration of work. Revetment and contraction works were thoroughly applied, using from time to time the best methods of construction which practice developed and the more substantial and costly ones which were proved to be necessary for effective and permanent results. Throughout the extent of this work at both of these reaches the improvement was marked, the low-water channel depth being doubled, or increased from 5 ft to 10. The theory, material, and details of construction were not new, but the scale and required strength were entirely unprecedented. . . .

"In the meantime, the demand for improved navigation was urgent and reasonable. . . . Under this pressure the attention of the Commission was directed to the great progress made, in late years, in the art of hydraulic dredging, and to the study of its application to the low-water navigation problem of the Mississippi River. In the year 1894 an experimental dredge was designed, built, and operated with such promise of success that the original project of improvement was amended to include the dredging of bars which obstructed low-water navigation so as to secure a navigable channel, at the lowest stages, with a depth of 9 ft and a width of 250 ft.

"There have now been built, besides the original and experimental one, eight dredges which are annually in commission during the low-water period, generally from August to near the end of the year. . . . These immense tools are capable of making a cut from 4 to 6 ft deep and from 40 to 60 ft wide, with a rate of progress of from 100 to 150 ft per hour, or half a mile per day. As a general statement it is true that . . . for the past three or four years, they have maintained a navigable channel throughout their field of operation, that is, below Cairo, of 10 ft at all times through all bars developing less than this depth of water. Their efficient operation depends upon frequent careful surveys and observations made as the low-water season approaches, and the skill of the officer in so locating the lines of the proposed channel as to coincide with the effort of the river and take advantage of its direction and force for enlarging the artificial route. In this, as in all other work on this great river, the natural trend of its power must be ascertained and encouraged. It is too strong to be thwarted by our greatest efforts.

"An important feature of any plan for the improvement of the alluvial part of the Mississippi River is the closure of outlets, for the reasons that they allow the dispersion of the energy of the stream, and the consequent impairment of its discharge capacity, and also that the restraining works, in the shape of weirs and levees, required to limit the discharge of an outlet and to conduct it to a proper outfall would be more costly in construction and maintenance than the works necessary to prevent them and confine the discharge of the river to a single channel."

Here is noted the first point on which present practice differs from that of the earlier days. Witness the Bird's Point–New Madrid floodway, the Bonnet Carré spillway, and the improvement in channel capacity of the Atchafalaya River. Again, in speaking of cutoffs, Harrod emphasized the principle that was adhered to by the Commission until 1933. The prevention of cutoffs he listed as one of the principal features of the plan for improving the river, and added: "Besides averting the local disturbance of regimen and alteration of bank and channel lines necessarily following a cutoff, it is thought that if the river is allowed to attain such an increase of length and reduction of slope and velocity as will permit an adjustment between its scouring power and the resistance of the material composing the banks, that caving, with its loss of land and levees, and the deposit of the debris on the bars below would be considerably checked, if not entirely prevented."

As for levees, said Harrod, there were a considerable number when the Commission was organized. However, the work had been done by county organizations and individuals, and was altogether insufficient in grade and strength. The flood of 1882 practically destroyed the system, and "it is doubtful if the courage or the resources of the country would have sufficed to justify further unaided efforts to rebuild [them] . . . had not the Commission made allotments from government appropriations to assist in closing two of the largest crevasses." It is of interest that the early levee-building engaged in by the Commission was limited to that considered as directly promoting the improvement of navigation. Not until 1896 did a more liberal view on the part of the federal government permit of general work along that line.

Such, briefly, was the work of Harrod and his associates in the improvement of the Mississippi River and the protection of its alluvial valley. The projects of later years have but carried further the developments they began.

The Drainage of New Orleans

Concurrently with his river work, Harrod was from 1888 to 1892 city engineer of New Orleans. He was then retained as advisory engineer for the drainage, sewage, and water works systems of that city, and from 1897 to 1902 he had charge of the drainage—both design and construction.

Among American cities, New Orleans presents a unique problem in drainage requirements, because of its high rainfall and general low elevation. (Standing in one of the principal streets, one must literally look up at the boats on the river.) As late as the 1890's open gutters and a soil saturated with filth and water to within a foot or two of the surface were the rule. At that time the city depended on a crude system of canals and pumps to keep itself above water, but these often proved entirely inadequate to prevent flooding of large areas. They were, in fact, makeshifts that had been installed from time to time to meet the immediate needs of small and disconnected areas.

The project designed by Harrod and his associates was intended to thoroughly drain and keep dry all the territory then built upon, as well as all areas likely to be developed within a reasonable time. It provided for a main drainage canal, nine miles in length; four relief canals; and five low-lift pumping stations. Most of the "canals," it should be pointed out, were covered conduits.

Of special interest from a technical standpoint was Harrod's substitution of electrically driven pumps and a single steam-electric central station in place of the steam-driven pumps originally proposed. It was somewhat of an innovation, and a considerable public issue was made of the foolishness of "using steam engines to drive dynamos to make electricity to operate motors to run pumps." Harrod also ran afoul of some real-estate speculators, by postponing the work in certain undeveloped areas in order to provide immediate relief where it was most needed. To add to his difficulties, the first pumps supplied by the manufacturers failed to work properly. And to cap the climax, a tremendous quarrel developed over his specifications for and selection of cement.

Harrod resigned and asked for an investigation, and a board of three engineers was selected to review the case. When the hearings began, one of the chief accusers appears to have found it suddenly desirable to drop the matter, for he twice refused, in writing, to amplify his charges or present himself at any of the sessions. The investigation continued, however, until a thorough study of all angles of the case had been completed. It resulted in a complete exoneration of Harrod.

Harrod's Views on Licensing, Ethics Codes, and Education

Space does not permit discussion of Harrod's activities on the Isthmian Canal Commission or of his later activities as a consulting engineer in New Orleans. Of more value in reflecting the character and professional ideals of the man will be a number of quotations from his presidential address (1897).

On licensing of engineers: "The attempt has been made by some professions, which has had sincerely in view the public and private interest, to. . .defend themselves against the Bashibazouks of the calling, by protective legislation. I believe that the experience of the past, in this direction, has not been encouraging, for, on the one hand, the public is disposed to view any such measure with a suspicion and resentment which would be likely to thwart its benevolent intention, and, on the other, the advancement of science is no longer an infant industry, needing protection against the waning powers of ignorance and pretension. It will be more satisfactory, in the long run, if the struggle for existence is allowed to go on, the engineer acquiring his status by hard work, and the people their experience by hard knocks, in order that adjustment may be final and permanent. The tendency is now towards the accomplishment of the same ends by a higher education, more scientific work, and closer personal and professional cooperation among members. In evidence of this is the increasingly thorough and extended courses in the better class of profession schools, the more general employment of trained engineers, and the growth of scientific societies in influence, activity and tone. The school and the society, rather than the legislature, are the tools we need for working out our professional salvation."

On codes of ethics: "Of course, a strong and cultivated moral sense, of which the Golden Rule forms the larger part—absolute good faith and fidelity towards all men, and particularly among fellow-workmen—is the foundation of all social and professional relations, being, perhaps, stronger and more necessary among engineers, in proportion as their responsibilities to the public and to each other are greater than in some other vocations. But this must be a plant of natural growth, with roots deep in the moral nature, made strong and hardy by exposure to the vicissitudes of life, and kept green by professional good-fellowship. A code which has to be proposed, and seconded, and debated, and amended, and passed by a majority vote, can hardly be counted on for the necessary virility in the time of trial. If the principles of such a code met with general acceptance there would be no occasion for its formal adoption. If they were not so accepted, its enforcement would be a matter of doubt and difficulty. If it were not uniformly enforced, a righteous expression and effort would fall into contempt, a desuetude which would not be innocuous, and the last state of that profession would be worse than the first. The prevalence of social order and the progress of humanity and culture is more largely the result of a trained and enlightened public sentiment than of all the laws and all the courts, and its influence will afford the surest reliance in the conduct of our public and private relations."

On formal education of engineers: "The accepted philosophy is that one law underlies all truth and its phenomena. One phase of it, the physical forces in Nature, is the foundation of all civil engineering, and a general knowledge of them and their laws is necessary for their successful utilization, in any department, in the service of man. This conviction of the importance of a liberal education as the foundation of eminent success in special branches of learning is now modifying the attitude of other professions and educational institutions. The greater universities of the country are now beginning to require a graduate's degree, as a condition of entrance, from those who propose to follow special courses in law, medicine and theology. The general movement for higher education will, in time, exact equal preparation in civil engineering and the other newer professions."

Harrod was elected a member of the Society in 1877, served as Director from 1892 to 1894, as Vice-President in 1895–1896, and as President in 1897. He died on September 7, 1912, survived by his second wife, Eugenia [Uhlhorn] Harrod, of New Orleans.

Local Sections Established in Mohawk-Hudson and Wyoming Areas

Resulting from recent initiative on the part of members in two districts of the country, and subsequent approval by the Board of Direction at its Jacksonville meeting on April 18, two new Local Sections have been established. What is even more important, these additions complete the coverage of the country, and there is now no area which remains unrepresented by some official Local Section.

Members in Wyoming gathered on February 10 at Casper, Wyo., to vote on a proposed constitution and elect officers. The new Section, subsequently authorized officially, will have headquarters at Laramie, Wyo.

The last of the Society Sections was initiated by a meeting at Albany, N.Y., on March 7. This group is to be known as the Mohawk-Hudson Section. With its establishment, by Board action, the subdivisional organization of the Society on a geographic basis, is complete. The total list of Local Sections now numbers 63.

Suggestions to the Young Engineer on Selling His Wares

Tips on Job Hunting, as Presented by an Authority at the Spring Meeting of the Conference of Metropolitan Student Chapters, at Rutgers University, March 19, 1938

By P. M. RUSSELL

PERSONNEL RELATIONS SUPERVISOR, NEW JERSEY BELL TELEPHONE COMPANY, NEWARK, N.J.

AN outstanding business executive has said that "the business of developing and selling your own wares is one that never ceases." If this statement is true—and it is—it gives a long-time importance to the situation in which many young engineers find themselves in June of every year. Men with shining new degrees are suddenly brought face to face with a problem for which they are relatively unprepared, that is, the problem of becoming salesmen of their abilities and capacities with sufficient effectiveness to gain for themselves an opportunity to work. This is doubly important when business activity is subnormal and the demand for graduates is reduced. Naturally you would like to know just how to improve your own chances under such conditions, and you may even hope for some ready formula that will give you all the right answers, but the problem is not as simple as that. About all I can do is to offer you one man's suggestions.

WHAT BUSINESS LOOKS FOR

Let me first ask you as young civil engineers to join me in doing a little market research so as to discover a few guides to what you might best do in building up your sales program. What the market (or business) expects in applicants might well be personalized at the outset because, whether you talk with a president, a superintendent, or a personnel director concerning the possibility of employment, you will find that each of them is, for the time, an interviewer, and in his interview with you he is looking for evidence of five specific things:

1. *Mental and personal integrity.* That is so well understood that we sometimes fail to emphasize its importance. Engineering training, however, with its rigorous demands for accuracy and its traditional respect for proofs, tends to favor you right at the outset.

2. *Ability and will to learn.* You can prepare yourselves rather easily on this point by having the facts as to accomplishment in your respective studies. Such evidence has a meaning, because the learning process must go on after you graduate. The most important difference in your postgraduate learning is that you must direct it with practical discrimination and with an increasing tendency to challenge yesterday's authority in the light of what has been discovered since yesterday.

3. *Ability and will to work.* Satisfactory performance under a light schedule will not carry as much weight as a good performance under a heavier load. This matter of personal production is important because the work situation in many companies requires the ability to concentrate and go on working in spite of surrounding activities which tend to interfere with individual application to the job in hand. Business has learned to beware of men who have been content with a record of "getting by."

4. *Ability and will to comprehend.* Comprehension, for the purposes of this discussion, is not easy to define. From the practical angle we may say, "It is the mental process which perceives the relationships of many factors in a given business problem, evaluates them carefully, and therefore brings to bear on a specific job an understanding which injects into that job greater values and meanings than could be accomplished by merely routine or line-of-least-resistance consideration." Comprehension of this kind puts your performance in a true perspective. It is a prime requisite for all kinds of planning, and the ability to plan well is essential for progress in many lines of work.

5. *Ability and desire to take responsibility intelligently.* Many men have not the capacity to carry any sizable amount of responsibility, and many others refuse to pay the price in personal effort which responsibility requires. You may think today that you would be the last person in the world to hesitate to accept responsibility, and yet there are very real penalties inflicted on men in business who accept responsibility without sufficient consideration and who later find themselves unable to measure up to the load. After seeing a few unfortunate instances of this sort you may feel that it is wiser to play safe and let somebody else "hold the bag." This latter attitude will probably not get you very far.

Our brief market research has indicated some of the principal characteristics that business looks for in applicants, and you may as well know that very few interviewers feel any great confidence in their methods of identifying these characteristics in you. Interviewers, if perfectly frank, would confess that business has made relatively little progress towards knowing just what the aptitude content of a given job really is. One prominent industrial psychologist comes to this conclusion: "The decisive test of interest—as of ability—will always be the occupational tryout." Such a confession should have a very definite meaning to you. It should convince you rather quickly that the market for your abilities (which is business) really needs intelligent sales effort on your part, and that the applicant who is well enough informed concerning himself to facilitate a reliable appraisal of his worth to a given company, will have a decided advantage over an applicant who still makes the buyer do the selling too.

JOB IMPLIES A CONTRACT

Having made these preliminary explorations into the market side of the picture, we can now discuss more pertinently what you as applicants may do in preparation for selling yourselves. Your first obligation, as I see it, is to assure yourself that you are willing to play the game according to the rules. Many a football player carrying the ball has had a temporary sense of achievement, only to find that he has stepped over a very important boundary line and that the ball has to be brought back. Many a real gain in yardage has been nullified because someone clear over at the other side of the line was offside. So it becomes important that you reconcile yourself to the acceptance of a job as an employment contract under which there may be a continuing exchange of values, but always subject to certain conditions or unwritten rules.

One of these rules is that accomplishment in business is usually cooperative. This means that your personal ambitions must lend a maximum of vigor to your own part of the work, and yet that you must accept group accomplishment as essential to individual success. Such a rule calls for a nice balance in your work attitudes.

Group effort, to be effective, imposes disciplines and authorities that may not be easy to accept. As a new employee, you will probably find yourself faced with rather narrow assignments for a longer period than you feel to be consistent with your college-graduate status. Impatience and dissatisfaction frequently result from this particular rule. It is right here that a man with real comprehension will have a definite advantage, because he will realize that his best chances of qualifying for broader assignments will come through his applying the broadest possible understanding to the narrow job in hand.

Another rule of the game is that every worker must accept an economic obligation to produce a value greater than his own remuneration, whenever this is possible. Unless this rule is followed in the aggregate, a business cannot long survive, and the best way of accomplishing it in the aggregate is for each employee to try to achieve it individually.

WHAT HAVE YOU TO SELL?

Having agreed in advance to the rules implied by the employment contract, we can now discuss the preparation for an intelligent sales program. In order to give you a clue as to the methods to be discussed, I should like to challenge you by the following questions: If you were a salesman for a real-estate development project, how would you sell a new house? Would you stand with your prospective buyers out by the front curb, assure them that the house had the requisite foundation, four walls, and roof; that it was newly painted; that it had eight rooms, and other specific characteristics, and then expect to close the sale while standing on the front curb? Or would you point out the exterior charm and setting and then take your prospects inside, where you could demonstrate all the fine points? Oddly enough, and tragically too, many college graduates have not progressed beyond the curbstone technique, and in these days are becoming increasingly depressed because they are unable to make a sale. The very difficulty of selling yourself to business today should make it apparent that your sales methods must be as carefully planned and as intelligently executed as possible. Of course the first thing for you to do is to find out what is in the house and then learn how to interpret what you find in terms of values to the buyer. You personally have considerable advantage over the salesman for the development company, because you have been present during every minute of the construction. In large degree, you were the one who decided on the general type of design, on its ultimate purpose, and you were responsible for most of the interior details. Therefore you can know, more accurately than anyone else, just what values you have to offer. Without this knowledge you are too much like a grab-bag, and business today isn't spending much on grab-bags.

Evaluating Your Past Development

There are many ways of developing the evidence for your sales program. I have no particular formula that can be applied to all cases. Certainly it seems reasonable that you might start with your boyhood interests and activities, identify various inherited characteristics, and find out to what extent your environment, your friends and relatives, your real understanding—or lack of it—led you in the first place to select civil engineering as a career. We may all be misled by our interests only to find that our actual abilities will not permit us to follow those interests occupationally. Therefore it is important to find out to what degree our interests are actually implemented by effective abilities.

Assuming that your selection of civil engineering as a college course was the right one for you, it then becomes necessary to evaluate not only your college work, but the entire range of activities during your years of development. Your engineering training, as such, should be looked on preferably as a kit of tools with its vocational uses to be influenced very definitely by the characteristics and values which you possess as a complex human being. Acceptance of this viewpoint right now may save you a great deal of disappointment, because all the records of groups of engineering graduates ten years out of college bring us unquestionable evidence of the way engineers work around in the course of time to vocations which offer scope for the whole man, including abilities not commonly thought of as "technical." Moreover, your best vocation will recognize the relative volume or development of your ability ingredients just as concrete mortar requires unequal amounts of cement, sand, and water for best performance. Your self-appraisal could be much more effective if industry or the psychologists could point out, with any certainty, even the approximate patterns and proportions of aptitudes required by each of a number of recognized types of jobs. In the absence of such patterns we can at least adapt the approach of Dr. Thurstone in his studies of "clustered interests" and their vocational meanings. This will help us to identify some of the principal abilities and interests necessary for high-grade performance in several major groups of occupations associated with civil engineering.

One obvious application of a civil engineer's training is in the field of structural design. Such work requires the relative mastery of the technical factors and a rather high ability to imagine, or conceive, the forms and relationships of the various members of a structural project.

The same kit of tools, together with the requisite perception of forms and relationships, when augmented by the desire to know more about materials, functions, and principles, would indicate technical research as a more suitable occupation.

If, in addition to the engineering fundamentals, you have definite planning ability combined with a good understanding of people and a strong directive force within yourself, you come close to having the essentials for the supervision of construction projects.

An aggressive financial ability, if supported by a good command of language and understanding of people, might well carry your engineering capacities into the field of sales—whether of building materials or equipment, or devices used in the course of construction.

The pattern of abilities required for selling physical products might easily be modified by a conception of mechanical devices and a natural interest in the avoidance of accidents, and so find its most effective expression in the casualty insurance lines.

Civil engineering ability, with special emphasis on the chemical and physical characteristics of materials, would suggest maintenance problems as a satisfactory field of endeavor.

We should not forget the teaching profession. A man who is to instruct students will need not only a broad knowledge of his subject, but also fluency of expression. In addition, he needs to find within himself a deep interest in the students' development. He must be able to derive—at least initially—an appreciable amount of his recompense from values that are not measured in terms of dollars.

Other aptitudes in you may suggest other combinations. You may have a strong bent for esthetic values; you may have that unusual clarity of thought and expression so valuable in engineering publications; you may find in yourself a deep interest in extending and improving the applications of known principles, which could lead to the planning of traffic systems, community development, or some entirely new method of home construction.

Select an Objective Toward Which to Work

The foregoing patterns may not be wholly accurate or complete, but they suggest the way in which the most suitable occupation for you is likely to be defined by the combination of technical and other strong abilities which you can identify in your own mind and experience. In other words, the one job in which you could be most effective lies within each of you, and it is exceedingly important that you try to discover, as nearly as you can, what that job is. You will then be able to direct your personal sales effort to those companies which may be able to provide that specific job or one closely related to it. In any case, if economic or other circumstances force you to adopt an opportunistic approach for the moment, you will have in your mind an objective toward which you can work in order that you may eventually find the proper outlet for your best abilities and gifts.

If you face today the problem of getting a job, you owe it to yourself—and to those who have enabled you to go through college—to tackle this problem with all the intelligence at your command. To this end, I am glad of an occasion to introduce Mr. Jones the engineer to Mr. Jones the salesman, and to recommend that you form a partnership on a very frank, thorough basis. Work out your sales program together now, and keep on adapting and improving it, because "the business of developing and selling your wares is one that never ceases."

Texas Section Has Gala Two-Day Spring Meeting

Engineers from all corners of the biggest state in the Union gathered in Houston for the spring meeting of the Texas Section on April 29 and 30. The registration, which totaled 286 members and guests, was one of the largest on record.

The first day's program included a general meeting in the morning, a luncheon, a technical session, and a dinner dance. On Saturday, following a short business meeting, the Section went by auto to inspect the new Galveston Causeway. A boat ride in the harbor followed, and on the return trip the party visited the San Jacinto battle grounds and the new monument. To round out the day, a sea-food dinner was served at the San Jacinto Inn by "friends of the Texas Section." The evening's entertainment included dancing, a skit, and a magician's show.

A surprise feature of the dinner dance was the presentation of a golf bag and clubs to J. T. L. McNew, president of the Section, and a traveling case to Mrs. McNew. E. P. Arneson, who made the presentation, called attention to Professor McNew's ten years of service as secretary of the Section, and stated that much of the development of the Section had been due to his efforts.

Of special interest at the business session was the report of the Student Chapter committee, which recommended the establishment of annual prizes for students in the four Chapters in the state —"and also for the Civil Engineering Society of Southern Methodist University until such time as a Student Chapter may be organized there." The recommendation, which was adopted, included a unique provision that should stimulate competition among the Chapters: the award money is to be proportioned in accordance with the size of the student organizations. Incidentally, the interest of the students in the Section's activities was reflected in the fact that more than 25 of them, representing three different Chapters, attended the meeting.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a large Number of National, State, and Local Engineering Societies Located in 40 States

MAKE WORK RELIEF PROJECTS WORTH WHILE

IN ANTICIPATION of the inauguration of another program of federal spending for relief purposes, and in the absence of a national inventory of public works deficiencies, the staff of the American Engineering Council has contacted engineer and administrative executives of the principal agencies of the federal government, administering the use of emergency funds, for factual information regarding the exploitation by public bodies of public works possibilities. None of the findings are official but they do represent frank interpretations of the observations of a number of conscientious individuals who have studied the work relief and public works projects heretofore submitted by the political subdivisions and public agencies of the United States.

Since there is so much more unemployment in the cities, emphasis is placed upon conditions governing municipal projects suitable for the more effective use of labor available in urban areas. It is assumed that sponsors and their engineers will continue to choose projects involving the immediate use of the training and experience of the men and women who are likely to be unable to find other work during those periods when such projects are scheduled to be in progress. These suggestions are, therefore, more in keeping with emergency needs for useful public employment than with normal public works engineering and construction.

Municipal projects, of a work relief nature, approved in recent years, are said to have aimed largely at city-wide improvement of streets, and traffic conditions, schools and school grounds, parks and recreational facilities, etc., in which the cities have contributed as little as possible and have forecast their needs to the practical limits of reasonable justification. For that reason, it is the opinion of some authorities that such fields of action have been so thoroughly exploited that they do not deserve so much attention for some years to come. From Washington, at least, it seems as if those who must develop work relief projects might render greater service to the communities, as a whole, by concentrating upon some of the following activities:

Sewage disposal systems, including treatment plants.

Water supply facilities including purification plants.

Grade separations and surveys for the ultimate elimination of superfluous grade crossings.

Major thoroughfares through slum areas and surveys of slum conditions for the advancement of slum-clearance work.

Urban mass transportation facilities, including waterfront improvements and the consolidation of freight and passenger terminals, etc.

Many of the projects which might be developed from these undersold classes of public work require state legislative action or the approval of voters to a bond issue to put the sponsor in position to finance its contribution. After such obstacles are removed, a greater participation by work relief agencies in non-labor costs may be required as a stimulus. In the case of slum clearance and the elimination of grade crossings, it may be necessary to provide long-term loans to the municipalities through appropriate agencies to enable them to acquire necessary rights of way and to finance a satisfactory portion of the initial expense.

Sewage Disposal Systems.—As an argument in support of projects for the construction or improvement of sewage disposal systems, it is reported that in many states there are numerous court decisions outstanding directing municipalities to comply with orders from state boards of health to cease discharging raw sewage into streams or lakes. Such orders have been unenforceable because of the inability of the cities concerned to obtain the necessary financing for the construction of sewage treatment plants on terms that the voters would approve. If the total cost of the work is borrowed, the sponsor will contract it; but if a lesser loan is permissible, the sponsor may have a choice between a money grant up to 45 per cent from PWA or a labor grant from WPA for the balance of the cost.

Water Supply Facilities.—The only cause for delaying the construction of water purification plants is said to be the inability of cities, towns, and villages to finance such improvements at reasonable rates. The greater ease of financing such projects proposed for the spending program would relieve this situation. Water works bonds secured by net income from water sales are, if within statutory limitations, excepted from city debt limitations. They may, therefore, be authorized with less delay to meet RFC requirements than might be required for other securities to be amortized from the general tax fund. The tendency in either event would be for the sponsor or borrower to contract the work or conduct it under local direction with non-relief labor, but it should be remembered that it is within the authority of the sponsor to specify the use by the contractor of local labor which might otherwise be on relief, without any participation by the work relief agencies.

Grade Separations.—Elimination of superfluous grade crossings and the construction of grade separations on major thoroughfares has been retarded by the inability of the railroads to bear their portion of the expense and by the lack of funds for such purposes in the hands of the interested political subdivisions. Superfluous crossings cannot be eliminated until grade separations are constructed within reasonable distances. State legislation will be required in some instances, but the RFC loans to railroads and the loan and grant schemes of the proposed federal spending program make it seem worth while to investigate possibilities for remedying the more dangerous crossing conditions.

Slum Clearance.—Slum clearance is usually identified with federal housing for low-income groups, but where funds are available, it may also be considered independently as a general civic betterment for the whole community. It has been observed that slum districts occupy a belt or zone in cities close to business centers where real estate is in transition from residential to commercial or industrial occupancy, where the buildings are run down, and where streets are narrow and unfit for better use. A modern method of improving these conditions, proposed by an engineer of much experience, is to cut a wide thoroughfare through the district from end to end, connecting it at the city limits with trunk lines of the state highway system. Along the line of the new thoroughfare, property may be acquired for parks and playgrounds, but the housing development would be left to public and private initiative in accordance with the requirements of the people.

The major obstacle in initiating a broad civic betterment program project of such constructive character has been the lack of funds to acquire the right of way. It might be removed if long-term federal loans become

Forecast for June "Proceedings"

MOTOR TRANSPORTATION—A FORWARD VIEW

A symposium in which Charles F. Kettering, M. Am. Soc. C.E., defines the joint responsibility of the automotive engineer and the civil engineer; Thomas H. MacDonald writes about "The Trend of Modern Highways"; and "Trunk Line Highways in Metropolitan Areas" is presented by LeRoy C. Smith, M. Am. Soc. C.E.

OBSERVED EFFECTS OF GEOMETRIC DISTORTION IN HYDRAULIC MODELS

by Kenneth D. Nichols, Jun. Am. Soc. C.E.

Experience with models at the Waterways Experiment Station, Vicksburg, Miss. This paper, originally intended for the May "Proceedings," was held over one month to permit the addition of important data.

THE THREE-POINT PROBLEM IN A COORDINATED FIELD

by R. Robinson Rowe, M. Am. Soc. C.E.

Description of an adroit solution of a problem commonly encountered in triangulation surveying.

RELATION OF RAINFALL AND RUN-OFF, TO COST, OF SEWERS

by John A. Rousculp, Assoc. M. Am. Soc. C.E.

Design charts for determining relative costs and diameters of storm sewers.

available. A second difficulty lies in the time required in the courts to condemn the right of way. A minimum of sixty days required for official procedure where prices of property are agreed to, may be lengthened to a year where there are appeals to jury verdicts; but where adequate financial resources are available, immediate entrance to the property could be obtained upon the execution of a bond to meet court verdicts regarding land values.

Subways.—It is reported that in 13 cities above 500,000 population and in others approaching that class, the necessity of acquiring greater street space for the movement of motor traffic has led to consideration of plans to put street-car tracks underground through the more congested districts occupied by office buildings, business, and industry. It is suggested that construction for this form of improvement, properly designed for train operation at a later date, would be of permanent character with a life in excess of any of the terms proposed for loans; and that the work would call for the services of many of the unemployed heads of relief families.

Waterfronts.—Although the preparation of projects for the improvement of waterfronts requires adjustment of the riparian rights of private owners as well as acquiring easements or title to the lands affected, such undertakings are being suggested among projects recommended for their permanent value. No revenue would be derived from this form of improvements except from dock leases. Condemnation proceedings would be a delaying factor but of minor importance if the work was divided into sections and regarded as a long-range program to be undertaken only in proportion to the unemployed labor available from time to time.

Joint Freight Terminals.—The impression prevails in Washington that consideration has already been given in numerous cities to the reduction of terminal costs by construction of joint freight terminals to be operated under joint billing arrangements and with container transfer service facilitating modern door-to-door delivery of package freight and greater shipping convenience. In some cities, the municipal and railroad authorities are reported to have tentatively agreed on general plans, but have been unable to proceed because of inability to finance construction. Aid in financing may soon become available. Such construction could offer opportunities for both contract and force account construction, some of which might use work relief labor on municipally sponsored projects in preparation for heavy construction.

As indicated in the foregoing review, such projects as those referred to require a considerable period for preparation. In some cities, however, where tentative plans are now ready and no new legislation is needed, the work may begin within a few months. In others, the requirements of official and legal procedure could delay action beyond the life of the proposed emergency program. In the meantime, it is suggested by engineers in contact with the situation that some parts of the more constructive projects using available relief labor might be initiated and carried on under projects whose payrolls could be met by the Works Progress Administration.

Highways.—Even though relief work on existing primary and secondary roads has been widely exploited during recent years, many thousands of farm families living in back-country areas are said to be still without roads to schools and markets which may be used in all weather without damage or excessive wear on teams and vehicles. Advance in this direction is believed to depend largely on the weight given to the broad social and educational advantages to be gained and on the need for a reservoir of employment in rural communities. Actual farm-to-market roads are also believed to be essential to economic stability in many counties.

Other Possibilities.—Other recognized possibilities for work relief and public work projects in suburban and rural communities include flood control and water conservation, grade separation at dangerous crossings, surveys for the location and evaluation of mineral resources, the conservation of soil, reforestation, and all practical measures for the conservation of other natural resources. Local cooperation with district, state, and national government agencies may be obtained by sponsors and engineers interested in developing such projects as integral parts of permanent improvement programs.

It is hoped that the summarization and interpretation of unofficial but responsible and interested thinking in Washington regarding ways and means for using emergency funds constructively may prove useful to engineers who are in position to influence the selection of public works and work relief projects in their home states, cities, and communities. In any event, Council is happy to report that engineers in the administrative offices in Washington are anxious to see whatever money may be appropriated from the federal Treasury for emergency purposes spent on work of the most permanent nature possible under existing circumstances.

Federal Housing Administration

Rehabilitation of hundreds of partially blighted residential neighborhoods is pointed out by the Federal Housing Administration, as one of the direct results of the subdivision review work of its Land Planning Section. The majority of more than 4,000 cases reviewed by that Section during the last three years have involved neighborhoods created prior to the depression which were allowed "to go to seed" during the period of building inactivity. Owners of subdivisions have been assisted in locating the causes of blight and in eliminating the defects which tended to make their properties undesirable.

Since this phase of housing activity always involves engineering, it is suggested that interested engineers communicate with Seward H. Mott, Chief of the Land Planning Section of the Federal Housing Administration, 1001 Vermont Avenue, N.W., Washington, D.C. In addition to changing the character of zoning and deed restrictions, Mr. Mott suggests changes in street layouts, inclusion of park sites, demotion of existing structures which may detract from the appearance of the area, etc. FHA advises with owners regarding the general layout of their properties but insists upon the use of both architects' and engineers' services.

Fees on Housing Projects for U.S.H.A.

Staff investigation of an early report that the U. S. Housing Authority wanted to drastically reduce the scale of fees to be paid by local housing authorities revealed the fact that U.S.H.A. officials were actually in favor of increasing allowances for architects' fees and anxious to see engineers properly compensated for the work they might do on housing construction for slum clearance purposes. AEC contacted AIA regarding the situation and the staffs of both organizations have busied themselves with the promotion of a better scale of fees.

As a result of the diligent efforts of committees of both architects and engineers, schedules of fees have been tentatively agreed upon which are better for all technicians than those heretofore used by the Housing Division of the Public Works Administration or those now in use by the Federal Housing Administration. Council continues its active part in this constructive piece of work and expects to be able to report the new schedule of fees for all work financed by U.S.H.A. at an early date.

Washington, D.C.
May 11, 1938.

In and About the Society

Members of the Spokane Section are scattered over a wide area comprising eastern Washington, northern Idaho, and western Montana. In order to plan a program of activities that will reach every member, so far as possible, the officers of the Section have distributed a questionnaire inviting individual suggestions. Each member is asked to state whether he prefers strictly technical evening meetings, luncheons, or dinner meetings; whether he thinks it practicable to have at least one meeting a year in his vicinity; and whether he would favor an annual one-day Section convention. A joint meeting and inspection trip at Grand Coulee with the Seattle and Tacoma Sections is also offered for consideration.

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Following the plan adopted last year, there will again be a June issue of Proceedings. It will be mailed to the membership on the fifteenth of the month. The two-month gap in publication of that journal, which formerly fell in June and July, thus comes again in July and August.

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To make sure that nothing of importance is missed by the editors of the Philadelphia Section's monthly publication, *The News*, blanks are distributed each month—with return-addressed envelopes—on which the members are asked to report items of interest. Among the suggestions are "accounts of engineering projects, work in progress, investigations, research, new ideas in design or construction, college activities including the Student Chapters, news of members, and employment opportunities."

Employment and the Engineer's Relation to It

A Summary of the Discussion at American Engineering Council's First Public Forum

By WILLIAM McCLELLAN, PRESIDENT, AMERICAN ENGINEERING COUNCIL, WASHINGTON, D.C.

On May 13, American Engineering Council inaugurated in Philadelphia the practice of holding open forums on public problems related to engineering. Ways in which employment can be increased and business aided were discussed by representatives of engineering, industry, economics, and finance, the speakers including Dr. Leo Wolman, Leonard J. Fletcher, Stephen DeBrul, and William J. Kelly. The following paragraphs are an abstract of the remarks of Dr. McClellan, who wound up the forum with a brief summary of the highlights of its two sessions.

ONE of the main points brought out in this discussion is that there is, though many of us did not previously realize it, a steady growth in what might be called "permanent unemployment." Figures have been presented to show that unemployment rises in successive periods of prosperity. That is, after a depression is over, a certain amount of unemployment is absorbed and the resulting unemployment may be expressed as X. Then another depression comes and the value of X rises again, but when prosperity returns apparently all the statistics show that this value never sinks to the old level.

Certain things indicate that this is a perfectly natural trend. It seems evident that, except perhaps under extraordinary conditions which we cannot now visualize, we can never expect to have 100 per cent employment, or if you please, zero unemployment. This is true even if we disregard the natural unemployables—those who will not work, such as hoboes, and those who are too old and feeble to work.

The second point is that unemployment seems to be far greater in those industries which have had the least technological advance. This has been borne out by analysis. It appears, therefore, that technological advance is not responsible for increasing unemployment.

Next comes the matter of government regulation of business. Even as far back as 1900 this was a factor, but it was moderate in amount and slow in application. At that time business was not in the terrible depression we have now, and was therefore able to absorb this change as it slowly took place. But there came a period, especially after the War, when this government interference with business was great in amount and rapid in application. Of course, no highly geared machine such as modern business is, could possibly adjust itself to it and to a certain extent it has wrecked the machine.

Another phase of the discussion centered on government spending, about which there was some difference of opinion. It seems to be the general idea that government spending—pump priming—is absolutely useless unless the pump (in this case our business system) is first put in order so that all it needs is a start. Apparently such spending, even somewhat beyond mere relief to prevent actual starvation and lack of shelter, might be advisable; but it becomes absurd uneconomic, and rather reckless if it is applied while someone is putting sand in the pump and doing other things to prevent it from starting. That seems to be the consensus of opinion here.

Then the question of saving has been considered somewhat at length. It is difficult to see how a country can get along without saving. There are people who say we ought to spend and spend and spend, as if spending for current goods—consumer goods—would answer the question. But spending for capital goods differs in no particular way so far as economy is concerned, except that it is more advisable and will produce wealth, whereas consumer spending will not.

For example, suppose a man is able to save $100 over and above what he needs to spend for mere living, and he wants to do something with it. What can he do? If he buys a few shares of stock his $100 is taken and spent for labor or materials, or other goods of a capital nature, which can produce and give a certain fair earning on that security. Someone else spends that money because the man himself cannot spend it directly for capital goods. Perhaps the "saver" will buy a home and keep on spending for capital goods that he controls himself. But there comes a time when he has spent for capital goods all that he personally can, and he still has some money left. Then the only thing he can do with it, for the welfare of the country, is to hand it over—get a token for it which will earn dividends or bond interest. Somebody else spends that money right here in the United States for labor and materials.

Now where is that money to come from if the people of the country do not, out of their earnings, save a certain amount and make it available to sustain present industries and create new ones? The value of saving is one of the important things brought out in this discussion.

A good deal has been said about the "erosion"—the ephemeral character—of capital. In the public utility industry, for example, the progress of invention has been so rapid that equipment has never realized what might be called its useful life as estimated at the time the money was invested; it has had to be thrown away before that time. The industry started with horse cars; then came cable cars and then bigger electric cars. And in certain places huge interurban systems were wiped out almost overnight by the coming of the automobile. Thus capital is to a certain extent ephemeral.

Now, certain favored industries, fortunate in their situation, may by accumulating reserves be able to cope with that trouble, but as has been pointed out, an ample reserve is not a general panacea. The problem must be solved in other ways.

Summarizing the results of the discussion, it can be said that the engineers present have learned the extent, the comprehensiveness of this problem—its extreme complexity, its difficulties. They have been impressed with the huge number of things that have to be considered; with the fact that no one mind can solve it all.

The engineer can play his part; the lawyer can play his part; likewise the industrialist, the business manager, the capitalist must each play his part. The result of a forum like this is to emphasize the difficulty of the problem, to show that it is almost arrogance for people who have never had any experience whatever with such matters, particularly the politician, who ordinarily is not a business man, to even think of tackling the tremendous difficulties involved.

Local Sections Supply Articles for "Civil Engineering"

FOR THE PAPER on military roads in Oahu, T.H., appearing in this issue, CIVIL ENGINEERING is indebted to the newly formed Hawaii Section, at whose inaugural meeting it was originally presented. Similarly, the story of the construction of Cajalco Reservoir is based on an address given before the Los Angeles Section.

Going back only two months, one will find five more articles originating with Local Sections. In May the Central Illinois and Metropolitan Sections were represented, respectively, by papers on highways and hydrology, and from a District Convention at Dayton, Ohio, came a paper on flood control. In April, the Mid-South Section supplied an article on hydrology and the Texas Section one on city planning.

The Society is indebted to the secretaries of Local Sections for keeping in mind the possibility of such use of their program material. Similarly, junior correspondents have proved helpful in supplying Headquarters with a brief report of papers that in their opinion might be suitable for CIVIL ENGINEERING.

News of Local Sections

Scheduled Meetings

CENTRAL OHIO SECTION—Luncheon meeting at the Chittenden Hotel on June 16, at 12 m.

LOS ANGELES SECTION—Dinner meeting at the University Club on June 8, at 6:15 p.m.

NASHVILLE SECTION—Dinner meeting in Kissam Hall at Vanderbilt University on June 7, at 6:30 p.m.

PHILADELPHIA SECTION—Outing and dinner on June 15 (for information call Engineers Club, Philadelphia, Pennypacker 5234).

SAN DIEGO SECTION—Regular meeting on June 23.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday, at 12:10 p.m.

San Francisco Section—Regular meeting on June 21.

Seattle Section—Dinner meeting at the Engineers Club on June 27, at 6 p.m.

South Carolina Section—Joint meeting with the South Carolina Society of Engineers at Charleston, S.C., June 10 and 11.

Spokane Section—Luncheon meeting at the Crescent Tea Room on June 10, at 12 m.

Tacoma Section—Dinner meeting at the Lakewood Community Center on June 14, at 6:30 p.m.

Tennessee Valley Section—Dinner meeting of the Knoxville Sub-Section at the University of Tennessee Cafeteria on June 2, at 6:15 p.m.

Texas Section—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on June 6, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on June 11, at 12 m.

Recent Activities

Central Illinois Section

All Central Illinois Section attendance records of recent years were broken when 30 members and 76 guests attended the April 7th dinner meeting, which was held in Champaign. The magnet for this large attendance was Arthur Casagrande, assistant professor of civil engineering at the Harvard University Graduate School of Engineering. Dr. Casagrande gave an illustrated lecture on "Frost Action in Soils," describing frost phenomena, experimental tests regarding frost action, and methods of combating this action.

Central Ohio Section

The regular monthly meeting of the Central Ohio Section took place at the Chittenden Hotel in Columbus on April 14. Due to the fact that R. R. Litehiser, president of the Section, recently accepted a position in another city, the nominating committee recommended that Robert N. Waid be advanced to the presidency from the position of first vice-president. It was further recommended that Henry D. Bruning be advanced to the position of first vice-president and that P. M. Holmes be made second vice-president. These recommendations, which will be in effect until the end of the 1938 fiscal year, were accepted with acclaim. The Section also voted favorably upon a motion to sponsor Clyde T. Morris, former Director from District 9, as a nominee for Vice-President of the Society from Zone III. The guest speaker was Kirk M. Reid, research engineer for the General Electric Company, whose topic was "Seeing on the Highway."

Cleveland Section

On April 5 members of the Cleveland Section gathered at the Mid Day Club for their monthly luncheon. A good crowd turned out to hear Elmer B. Wight, of the Wight-O'Rourke Company, civil engineers and surveyors, speak on "Old Lines and Old Trails." The human-interest and historical aspects of this topic were stressed by Mr. Wight, who has made the subject his hobby as well as his profession.

Colorado Section

A meeting of the Colorado Section, sponsored by the members of the Section who are in the Denver water department, took place on April 11. The first speaker was Harry Potts, special engineer for the Denver Municipal Water Works, who showed films on the construction of the Ralston Creek Dam and the lining of the Moffat Tunnel pioneer bore for the diversion of water. He was followed by Earl L. Mosley, city manager of Colorado Springs, who discussed the water supply system of Colorado and showed a motion picture of the construction of the system.

The Junior Association of the Colorado Section met on January 25, with 11 present. The speaker on this occasion was A. E. Perlman, maintenance-of-way engineer for the Denver and Rio Grande Railroad, who related some of his experiences in railroad engineering. Another meeting of the Junior Association took place on March 28. Following some announcements and business discussion, Charles O. Woodworth, manager of the Denver municipal airport, was introduced and spoke on the operation of the airport and its equipment. An enthusiastic discussion concluded the meeting.

Connecticut Section

Among the 32 members and guests present at the April 27th meeting of the Connecticut Section were several members of the Yale University Student Chapter. Preceding dinner, which took place at the Graduates Club in New Haven, the following officers were elected for the coming year: R. H. Suttie, president; Warren J. Scott, vice-president; and Joseph P. Wadhams, secretary-treasurer. The speaker of the evening was C. W. Dunham, assistant engineer for the Port of New York Authority, who gave an illustrated talk on the construction of the Lincoln Tunnel.

Ithaca Section

A meeting of the Ithaca Section took place at the Mark Twain Hotel in Elmira on April 21, with 51 present. A dinner preceded the meeting. The technical program consisted of an interesting paper on rigid steel frames, which was presented by Harold H. Hussey, designing engineer of the American Bridge Company.

Kansas City (Mo.) Section

Numerous business matters were discussed at a meeting of the Kansas City (Mo.) Section, which took place at the University Club on April 14. It was moved, seconded, and unanimously adopted that E. B. Black, former Director of the Society, be nominated as a candidate for Vice-President from Zone III. An interesting illustrated talk on aerial photography and mapping concluded the evening. This was given by H. L. Lowe, chief draftsman of the flood control division of the U. S. District Engineer Office. There were 41 present. On April 15 R. C. Gowdy, Vice-President of the Society, visited the Section and had luncheon with a group of members.

Kansas State Section

On April 4 the Kansas State Section and the University of Kansas Student Chapter were guests of the Kansas State College Student Chapter at a smoker, which was held in Manhattan, Kans. There were 150 present on this occasion, which was the first of a series of gatherings intended to promote a closer relationship between the Section and its neighboring Student Chapters. The program consisted of a short business meeting; a talk by W. E. Baldry, president of the Kansas State Section; two readings by Loyola Van Dorn, member of the Kansas State College Student Chapter; and motion pictures of Germany. A fine buffet supper and social hour concluded the evening.

Los Angeles Section

There were 201 members and guests present at the April dinner meeting of the Los Angeles Section, which took place at the University Club on the 13th. Following dinner E. Harrison King, professor of civil engineering at St. John's University in Shanghai, gave an interesting talk on life in China. The other speakers on the program were Howard L. Way, county surveyor and highway commissioner of San Bernardino County, who described the damage done in that area by the flood of March 2; M. N. Thompson, chief engineer of the Orange County Flood Control District, who showed lantern slides of the flooded area; and E. A. Reinke, senior sanitary engineer of the California State Board of Health, who discussed the flood in relation to sanitary facilities in southern California.

Louisiana Section

A meeting of the Louisiana Section took place in New Orleans on April 9, with 30 in attendance. The feature of the occasion was a talk by Henry E. Riggs, President of the Society, who gave an interesting résumé of the activities of the Society.

Metropolitan Section

A paper on the Works Progress Administration comprised the program at the April meeting of the Metropolitan Section, which was held in New York City on the 20th. This was presented by Brehon B. Somervell, administrator for the Works Progress Administration of New York City, who reviewed the highlights of the organization and its accomplishments and outlined suggestions for a permanent relief program on a national basis, with the possibility of expansion in the event of a depression. The meeting, which was attended by 375, was followed by refreshments and a social session.

Miami Section

At the March meeting of the Miami Section, M. N. Lipp, city engineer of Miami Beach, described the outfall sewer recently placed in service there. This installation runs into the Atlantic Ocean nearly to the Gulf Stream. Several business matters were discussed at the dinner meeting held on May 5. The reports of those who attended the Spring Meeting of the Society in Jacksonville proved of lively interest, and there was a timely paper on the sewerage problems of Miami. This was presented by Charles S. Nichols, director of public service and city engineer of Miami. The attendance was 18.

MICHIGAN SECTION

There were 73 present at the March meeting of the Michigan Section, which was held at the Hotel Statler in Detroit on the 18th. The technical program consisted of a talk by Linton Hart, district manager for the Raymond Concrete Pile Company, on the topic, "Foundations for Buildings in Detroit." Mr. Hart, whose career in subsurface work has taken him to many countries and placed him in the front rank of foundation engineers, limited his talk to various types of point bearing piles and caissons. Caisson construction, by means of a huge auger, was one of the spectacular methods which he described. A spirited discussion between proponents of point bearing piles and friction piles followed his talk.

NEBRASKA SECTION

Members of the Nebraska Section enjoyed a dinner meeting that took place in Omaha on April 1. The program consisted of an address by T. R. Agg, dean of engineering at Iowa State College and Director of the Society, whose topic was "Engineering in This New Era"; the presentation by Floyd Horn, engineer for the Northwestern Bell Telephone Company, of a film entitled "The Plow That Broke the Plains"; and an address by R. N. Towl, consulting engineer, on the effect of Missouri River improvements on floods and river traffic. This interesting program elicited considerable discussion. There were 40 present.

NEW MEXICO SECTION

The April meeting of the New Mexico Section was held in Albuquerque on April 26, in connection with a meeting of the Southwestern Division of the American Association for the Advancement of Science. The attendance was 14 members and a like number of guests. The secretary read a letter from R. H. Rupkey, who resigned as president of the Section because he is leaving the state. The meeting was then turned over to John D. Clark, head of the department of chemistry at the University of New Mexico, who explained and amplified subjects dealing with chemistry as affecting the engineer.

NORTH CAROLINA SECTION

A number of interesting events were scheduled for the annual meeting of the North Carolina Section, which took place in Pinehurst on April 30. Perhaps the highlight of the occasion was the Student Chapter competition, in which six papers were presented. The winners in this contest were Charles Ramsey, of Duke University; R. K. Morton, of the University of North Carolina; C. A. Crawford, of Duke University; and Sam Hayworth, of North Carolina State College. The speakers on the technical program were R. A. Moncrieff, of C. T. Main, Inc., Boston, Mass.; R. Getty Browning, of the North Carolina State Highway and Public Works Commission; C. T. Wanzer, division engineer for the Duke Power Company; and Wilbur S. Smith, traffic engineer for the South Carolina State Highway Department. The speaker at the mid-day luncheon was Charles M. Upham, engineer-director of the American Road Builders Association, who discussed the subject, "Highway Progress and Future Development." During the business session the following officers were elected for the coming year: W. E. Vest, president; O. B. Bestor, senior vice-president; A. C. Lee, junior vice-president; and Harold C. Bird, secretary-treasurer. The total of 77 present included L. F. Bellinger, Vice-President of the Society, and 40 students.

NORTHEASTERN SECTION

"Flood Protection Works at Springfield, Mass.," was the subject of a symposium presented at the March meeting of the Northeastern Section, which was held in Boston on the 30th. The first speaker on this program was Lt. Col. John S. Bragdon, district engineer for the Providence District, who gave a general review of the whole Connecticut River flood-protection plan; Capt. Robert E. York, executive officer of the Providence District, who discussed the work now under way in Springfield; Frank A. Marston, consulting engineer of Boston, whose topic was the supplementary sewerage and drainage works in the Springfield area; and Lt. Col. Albert K. B. Lyman, district engineer of the Boston office of the Corps of Engineers. There were 105 present at the meeting, and 80 at the dinner preceding it.

NORTHWESTERN SECTION

An unusually large attendance enjoyed the April 12th meeting of the Northwestern Section, there being 62 at the dinner preceding the meeting and 90 at the meeting itself. Following a brief business session, Colonel Fleming, district engineer for the St. Paul District, was introduced and gave an instructive talk on the "St. Anthony Falls Development for Navigation," describing the geology of the site and discussing the interesting design and construction problems involved.

PANAMA SECTION

Seventeen members and guests enjoyed a meeting of the Panama Section, which took place in Panama City on April 4. The technical session consisted of a talk by John C. French, who discussed hydraulic model studies of the design of the conduit entrances of the Madden Dam sluiceways, made at the Carnegie Institute of Technology, Pittsburgh, Pa., under the supervision of the U. S. Engineer Office. Colored motion pictures of typical tests were shown by Lawrence Johnson, in connection with Mr. French's talk. Following a general discussion of the tests, there was a short business meeting.

PITTSBURGH SECTION

Two interesting meetings were enjoyed by the members of the Pittsburgh Section during April. On the 14th there was a luncheon, which was attended by 35. The list of guests included Hardy Cross, head of the department of civil engineering at Yale University. On the 27th the Pittsburgh Section of the Society and the civil engineering branch of the Engineers Society of Western Pennsylvania held a joint meeting, which was attended by 129. The speakers on this occasion were the Hon. Grover C. Ladner, judge of the Orphans Court, Philadelphia, Pa., and H. E. Moses, chief engineer of the Pennsylvania State Department of Health. An extensive and interesting discussion concluded the meeting.

PORTLAND (ORE.) SECTION

There were 30 present at a meeting of the Portland (Ore.) Section, which was held on April 21. Numerous business matters were discussed at this session, including the final draft of the new Local Section constitution, which was presented by R. B. Wright, chairman of the committee. A motion was made, recommended, and passed that the Section contribute to the loan fund for needy students at Oregon State College, and it was voted to accept the plans of liquidation proposed for the unemployment fund by the Oregon Technical Council. A motion was also made and passed that a committee be appointed to work toward a revision of existing state statutes, so that the state engineer be given authority to undertake and to cooperate in snow survey work.

ROCHESTER SECTION

A special joint luncheon meeting of the Rochester Section of the Society, the Rochester Society of Architects, and the Rochester Engineering Society took place on April 5, with an attendance of 105. The speaker on this occasion was Harold W. Baker, city manager of Rochester, who outlined Rochester's planning program and described its accomplishments over a number of years.

SACRAMENTO SECTION

During March and April the Sacramento Section continued its custom of holding weekly luncheon meetings, which have attracted a considerable number of members and guests. Among the speakers at the March sessions were Samuel B. Morris, dean of the school of engineering at Stanford University; Henry E. Riggs, President of the Society; Milo S. Farwell, consultant for the Bethlehem Steel Company; and C. R. Montgomery, attorney for the California Division of Highways. At the meeting held on the 22d a resolution of regret at the death of Charles Stockton Pope, a charter Member of the Section and its third president, was passed. On March 29 there was an evening meeting conducted by the Juniors. At this session a resolution of sympathy at the death of Samuel Alexander Hart, another member of the Section, was passed. The program consisted of "chalk talks" by Arthur

Elliott, an amusing dramatic skit, and a talk by James Jennison on the deflection of tall buildings due to earthquake vibrations. The speakers at the April meetings included Allen Nicol, of the California Division of Highways; Cyril Thomas, engineer for the Natomas Company; and Arthur S. Dudley, of the Sacramento Chamber of Commerce. On April 23 a field trip was made to the site of the Natomas Company's gold-dredging operations.

St. Louis Section

A joint meeting of the St. Louis Section, the Washington University Student Chapter, and the civil engineering department of Washington University, which was held at Washington University on February 2, attracted an attendance of 250. The feature of the occasion was a film on the construction of the Golden Gate Bridge, which was shown through the courtesy of the Bethlehem Steel Company. On March 28 a regular meeting of the Section was held at the Mayfair Hotel in St. Louis. After a discussion of Society affairs, McCune Gill gave an interesting talk on the history of St. Louis. The attendance was 49. At the meeting held on April 25 W. J. Burton, assistant to the chief engineer of the Missouri-Pacific Railroad, spoke on the subject of early railroad history. There were 37 present.

San Francisco Section

On April 2 about 250 members of the San Francisco Section enjoyed an excursion to the site of the 1939 exposition, where they inspected the buildings under construction. A dinner meeting of the Section took place at the Engineers Club on April 19, with 156 present at the dinner and 200 at the meeting. The speaker of the evening was Edward Hyatt, state engineer of California, who discussed the flood control problems of the state.

Seattle Section

Discussion of business matters and forthcoming Section activities occupied part of the program at the April 11th meeting of the Seattle Section. The technical program consisted of a talk by J. D. Littlepage, who chose for his subject, "Mining in Russia." Mr. Littlepage spoke from the vantage point of ten years of experience in Russia, where he supervised the installation of American machinery in mines and taught American methods.

Spokane Section

Eight members were present at the April 8th meeting of the Spokane Section, which as usual took the form of a luncheon at the Crescent Tea Room. This session was devoted entirely to business discussion and to making plans for forthcoming meetings.

Syracuse Section

On March 14 the Syracuse Section, with the Technology Club of Syracuse, sponsored a symposium on public health. The speakers on this program were Dr. Philip Rafle, district state health officer; Dr. H. B. Doust, commissioner of health for the city of Syracuse; and A. F. Dappert, principal sanitary engineer for the State Department of Health, who discussed their various functions in relation to public health. The attendance of 175 included members of the Onondaga Medical Association. Prior to the meeting, the Section entertained the speakers at dinner. On April 6 the Section held a dinner and business meeting at the Onondaga Hotel. After the business session Henry Howe, city engineer of Rochester, N.Y., gave an illustrated talk on several projects recently completed in Rochester.

Tacoma Section

There were 53 present at the April meeting of the Tacoma Section, which was held at the Lakewood Community Center on the 12th. During the business session announcements were made, and a resolution of sorrow at the death of William J. Roberts, Life Member of the Society, was passed. The speaker was John K. Ball, chief stress engineer of the Boeing Airplane Company, who gave an illustrated talk on the structural design of airplanes.

Tennessee Valley Section

The Chattanooga Sub-Section of the Tennessee Valley Section held its monthly meeting on April 13, with 78 present. On this occasion, which was "Ladies Night," A. R. Cahn presented his color motion picture of the flora and fauna in the Norris Dam area.

There were 28 present at the May meeting of the Knoxville Sub-Section, which was held on the 5th. On this occasion H. L. Fruend, president of the Section, gave a report on the Spring Meeting of the Society.

There was a record attendance of about 500 at the April meeting of the Muscle Shoals Sub-Section, which took place at Pickwick Dam, Tenn., on the 14th. The meeting began in the afternoon with an inspection of the dam. Following this, dinner was served, and the group adjourned to an auditorium to hear a talk by Harry Wiersema, general office engineer for the Tennessee Valley Authority. Dr. Cahn's colored motion picture concluded the program.

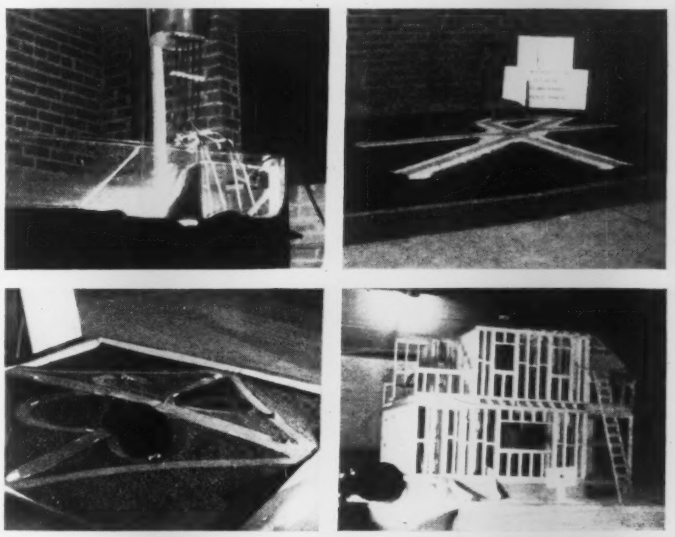
Student Chapter Notes

Pennsylvania State College

The Pennsylvania State College Student Chapter reports that it was well represented at the Student Chapter convention at Newark, Del., three seniors and five juniors having made the trip. Curtis Yamas, a junior, read a paper on welding, but was barred from competition because of his class. A number of Chapter members have registered to attend the civil engineering summer camp.

North Carolina State College

It was estimated that 10,000 guests visited the exhibits at the annual Engineers Fair, held at North Carolina State College on April 8. The fair was unusually interesting this year, and the civil engineering exhibits, which were built by members of the North Carolina State College Student Chapter and the student branch of the Association of General Contractors, received much commendation. The accompanying photographs show some of the prize-winning exhibits.



Some of the Exhibits Shown at the North Carolina State College Engineers Fair

Oregon State College

The Oregon State College Student Chapter reports that its activities during the past semester have consisted largely of regular meetings, at which both technical and non-technical talks were presented. Among the speakers on these occasions were Lt. Louis R. Wirak, of the department of military science; A. J. McAdams, representative of the E. I. DuPont Company; and a representative of the John A. Roebling's Sons Company, who showed interesting pictures depicting the development of the suspension bridge. The traditional term breakfast, which was attended by approximately 100, was addressed by Father John B. Delaunay, dean of men at the University of Portland. Through the efforts of Ed Gray, president of the Chapter, a loan fund has been established to aid needy engineering students.

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

The Michigan College of Mining and Technology Student Chapter reports that it has had several interesting meetings. On February 23, E. C. Wenger, of the Portland Cement Association, gave an illustrated lecture on concrete road design, explaining the calculation of size and frequency of loads. At the March 17th meeting slides of the Cascade Tunnel were shown, and at the March 31 meeting G. W. Koronski, superintendent of the Gogebic County Road Commission, discussed the various aspects of snow removal.

RECENT VIEW OF MICHIGAN COLLEGE OF MINING AND TECHNOLOGY STUDENT CHAPTER WITH SOME OF ENGINEERING FACULTY

TEXAS TECHNOLOGICAL COLLEGE

The annual Engineers' Show at Texas Technological College was held April 8–9. The purpose of this exhibition is to display part of the students' work, to demonstrate the use of laboratory equipment, and to show the advances being made in engineering. An extensive exhibit was entered by the Texas Technological College Student Chapter and the civil engineering department, under the direction of John Emmett, a member of the Student Chapter. These exhibits included a cross-section of a rolled earth-filled dam, a working model of an aggregate screening plant, a deck-plate girder bridge model, models of various types of highway intersections, and a model of a concrete arch-suspension bridge. The latter exhibit is shown in the accompanying photograph.

MODEL OF CONCRETE ARCH-SUSPENSION BRIDGE DISPLAYED BY TEXAS TECHNOLOGICAL COLLEGE STUDENT CHAPTER

UNIVERSITY OF ILLINOIS

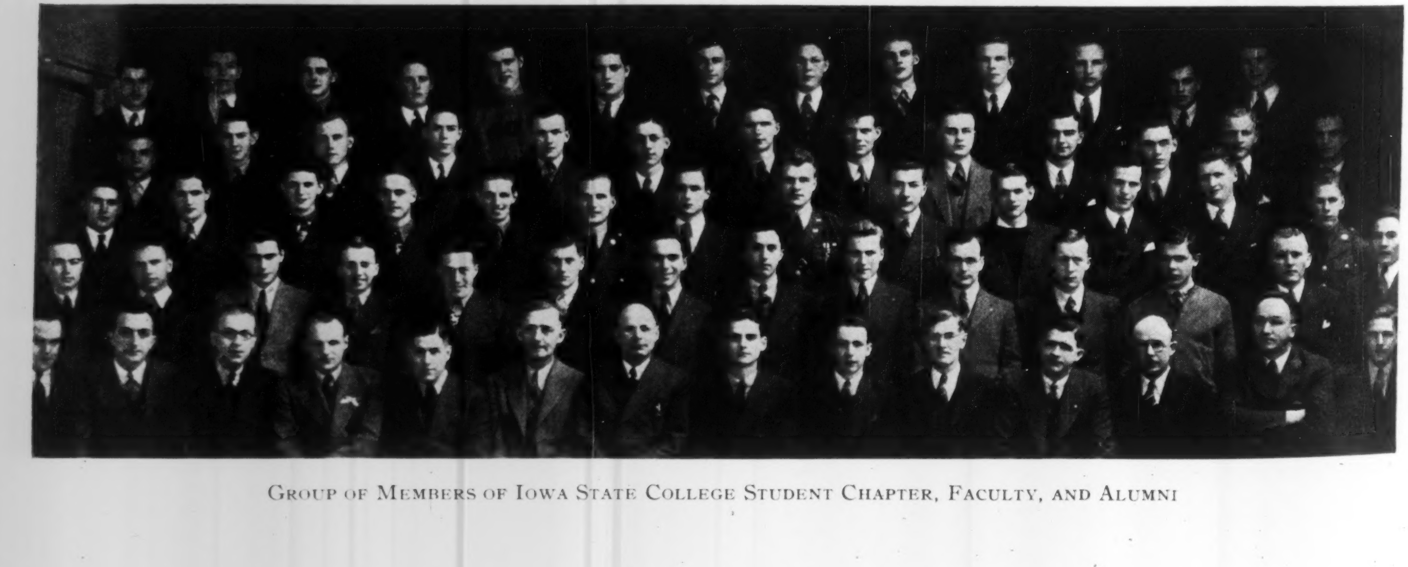
On March 2 the University of Illinois Student Chapter enjoyed an interesting talk on "Shell Domes and Barrel Shell Roofs," given by Anton Tedesko, of the Roberts and Schaffer Company. On March 17 the members heard L. F. Harza, of the Harza Engineering Company, discuss the recent California flood. About 400 were present at the meeting held on April 6, which was addressed by Arthur Casagrande, professor of engineering at Harvard University. Dr. Casagrande showed a sound motion picture of the new German highways and slides illustrating the construction of these roads.

UNIVERSITY OF MICHIGAN

The initiation banquet of the University of Michigan Student Chapter, held on March 30, proved a very interesting affair. Lewis M. Gram, professor of civil engineering at the University of Michigan, presided, and an address was given by William H. Adams. Captain Adams, who is supervising engineer of the inspection division of the PWA, Detroit, Mich., spoke on the subject, "Some Unmarked Paths in the Engineering Field."

IOWA STATE COLLEGE

On April 6 the Iowa State College Student Chapter held its third annual spring banquet to welcome the freshmen who have chosen civil engineering as a profession. Over thirty of the fifty-three freshmen were present and received a hearty welcome. After dinner, songs were sung, and T. R. Agg, Director of the Society and dean of the engineering school, spoke briefly, stressing the importance of the student branches of the Founder Societies. The concluding feature of the evening was a motion picture showing the construction of the Golden Gate Bridge, which was presented by C. W. Carter, of the Bethlehem Steel Company. The banquet was attended by about 130 students, members of the faculty, and alumni, part of the group being shown in the accompanying photograph. In spite of the fact that the heaviest snow storm of the year was raging, about 700 outsiders joined the group for the showing of the motion picture.



GROUP OF MEMBERS OF IOWA STATE COLLEGE STUDENT CHAPTER, FACULTY, AND ALUMNI

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for July

AN ACCOUNT of the uplift measurements made at the Holtwood Dam of the Pennsylvania Water and Power Company is an important contribution to the July issue of CIVIL ENGINEERING. "No such measurements," says the author, Paul E. Gisiger, M. Am. Soc. C.E., "appear ever to have been made in a similar manner on a dam where no piezometer shafts had originally been provided." Both the technique of testing and the results of the observations are described.

CORE DRILLING FOR UPLIFT TESTS AT HOLTWOOD DAM

In the July issue will appear also the paper by Clarence W. Hubbell, M. Am. Soc. C.E., originally announced for June, on the background of Detroit's sewage disposal project. The remainder of the issue will be devoted in the main to abridgments of papers presented at the Jacksonville Meeting. For road builders and soils technicians there will be a group of articles on soil sampling and testing and soil stabilization methods. Sanitary engineers both in coastal regions and in the interior, will find much of interest in a discussion of the effects of industrial wastes and sewage on shell fish and fin fish. And there will be additional papers in the fields of surveying, hydrology, erosion control, and structural engineering.

Washington Award to Frank Baldwin Jewett

FRANK BALDWIN JEWETT, past-president of the American Institute of Electrical Engineers, was formally presented with the Washington Award for 1938 at a dinner in Chicago on May 5. The fifteenth recipient of this award, Dr. Jewett was cited "for inspiring and directing scientific research leading to improvements in the art of communication."

The Washington Award was founded in 1915 by John W. Alvord, Hon. M. Am. Soc. C.E., and is administered by the Western Society of Engineers. It is described as an honor "conferred upon a brother engineer by his fellow engineers on account of accomplishments which preeminently promote the happiness, comfort, and well-being of humanity." The Commission of Award includes members of the Western Society of Engineers and of the four Founder Societies.

Prizes Given by A.I.S.C. for Elevated Highway Design

FIRST PRIZE of $5,000 in the American Institute of Steel Construction's design competition for elevated highways has been awarded to Craig P. Hazelet, M. Am. Soc. C.E., and Ingolf Erdal, of the firm of Hazelet and Erdal, Chicago. Second place—$2,000—went to the firm of Madigan–Hyland, New York, of which Emil Praeger, M. Am. Soc. C.E., is chief engineer, and C. F. Loyd is architectural designer. In third place—a $1,000 award—was Walter W W. Jones of New York.

The contest rules called for a plan that would provide for complete physical separation of streams of traffic moving in opposite directions; eliminate direct access to abutting property; eliminate all intersections; and provide accelerating and decelerating lanes for vehicles entering or leaving the highway. In all, 273 designs were submitted.

Among the winners of the ten honorable mentions were W. E. Reynolds, M. Am. Soc. C.E. (jointly with Gilbert Stanley Underwood); Charles M. Noble, M. Am. Soc. C.E. (jointly with Milton Brumer and A. Gordon Lorimer); and Max Schlesinger, Jun. Am. Soc. C.E.

American Engineer Attends Australian Celebration

As representatives to the conference of the Australian Institution of Engineers, held in Sydney during the week of March 28, the Society designated Sir John Henry Butters, a resident of Sydney, and Col. William G. Atwood of New York. The conference was in connection with the celebration of Australia's one hundred and fiftieth anniversary.

Colonel Atwood supplies the following account of his reception:

"The only duties of your ambassador were to reply to the welcome of the Lord Mayor of Sydney and pass out a few remarks following Lord Wakefield, Governor General of New South Wales, when he opened the conference—and also to receive a great deal of very pleasant hospitality.

"One thing that the Institution of Engineers does is to get publicity. They had a special magazine section of the principal Sydney paper on the Sunday preceding the opening of the conference, with articles by their prominent members and many interviews with visiting and other members all through the week.

"The hospitality of the Australians has to be experienced to make it possible to realize that such thoughtfulness exists. Sir John Butters refused to take any part. He said that as long as there was a 'real live American' to represent the Society, nobody wanted to see an Australian in that rôle. He and Lady Butters were very kind to us. Sir Henry Barraclough, a Cornell graduate of my time, and Lady Barraclough were also very hospitable."

Bureau of Reclamation Issues New Books on Dams

THE FIRST two of a proposed series of 41 bulletins descriptive of the Boulder Canyon Project have recently been published by the Bureau of Reclamation. When complete, the series will record the history of the project, the results of the technical studies and experimental investigations, and the more unusual features of design and construction. It gives promise of being one of the most thorough reports of an engineering project ever prepared.

Bulletin 1 (190 pages) is entitled "Model Studies of Spillways," and Bulletin 2 (165 pages), "Model Studies of Penstocks and Outlet Works." They are profusely illustrated, printed on coated paper, and in cloth covers sell for $1.50 each. In paper binding the price is $1.00. They can be obtained from the offices of the Bureau of Reclamation in either Denver, Colo., or Washington, D.C.

Another recent publication of the Bureau is a second edition of "Dams and Control Works" (Government Printing Office, Washington, D.C., $1.00). It includes a description of 21 representative storage and diversion dams and high-pressure reservoir outlet works constructed by the Bureau, and many special articles on such subjects as dam design, hydraulic and structural model testing, and concrete laboratory operations and temperature control.

Rhode Island Adopts License Law for Engineers

ON APRIL 23, 1938, Rhode Island was added to the list of states requiring registration of engineers. The provisions of the new legislation closely parallel those of the "Model Law" framed by representatives of the American Society of Civil Engineers and a large number of other engineering societies.

There now remain only eight states in which some form of licensing is not in effect.

Croton Lake Bridge

The artistic view of the Croton Lake Bridge, printed in this issue on the "Page of Special Interest," is ample commentary on the excellent parkways developed by Westchester County, N.Y. This bridge, one of the largest structures in the park system, was designed for the Westchester County Park Commission by H. C. Baird, M. Am. Soc. C.E.; the architect was Clinton F. Loyd.

Brief Notes from Here and There

King County, Washington—which includes the city of Seattle—is the first county in the Northwest to have county zoning, as well as complete platting regulations. The ordinances, as adopted by the county commissioners, are the work of the King County Planning Commission, of which Joshua H. Vogel, M. Am. Soc. C.E., is planning engineer and executive officer, and Richard G. Tyler, M. Am. Soc. C.E., is chairman. The use of billboards and other advertising signs comes in for special attention, and outdoor advertising companies are being given time to make the necessary adjustments. Mimeograph copies of the zoning and platting regulations (32 and 16 pages, respectively) have been filed in the Engineering Societies Library, 33 West 39th St., New York, N.Y.

* * * *

Of the eight new directors of the American Water Works Association who took office at New Orleans, April 28, 1938, four are members of the American Society of Civil Engineers. They are: George H. Fenkell, Member and former Director, Am. Soc. C.E.; H. Lloyd Nelson, Assoc. M. Am. Soc. C.E.; Samuel F. Newkirk, Jr., M. Am. Soc. C.E.; and Earle L. Waterman, M. Am. Soc. C.E.

NEWS OF ENGINEERS

Personal Items About Society Members

Dean G. Edwards has been appointed consulting engineer of the Borough of Manhattan, New York. He was formerly consulting engineer for the Citizens Budget Commission.

S. C. Gill, Jr., is now surveyman for the Corps of Engineers, U. S. Army, Rock Island District. Until lately he was a rodman for the Chicago, Milwaukee, St. Paul and Pacific Railroad.

Robert G. Montgomery has accepted a position in the Michigan State Highway Department, with headquarters in Lansing.

Samuel A. Brady has resigned as assistant regional officer for the National Park Service at Sikeston, Mo., to organize the Bramur Oil Company, of which he is secretary and treasurer. His company is located in Poplar Bluff, Mo.

Francis Tingley, previously with Ford, Bacon and Davis, Inc., of New York City, has accepted a position with the Pennsylvania Public Utility Commission, with headquarters in Pittsburgh, Pa.

Eldon S. Clark, until recently with the Timkin Axle Company of Detroit, has become superintendent of the iron foundry of the Banner Iron Works, at St. Louis, Mo.

C. F. Bird, who has been with Shoecraft, Drury and McNamee, of Ann Arbor, Mich., recently joined the staff of the construction bureau of the Detroit Edison Company.

Joseph M. Esterman, formerly senior engineering aid for the State-Wide Highway Planning Survey, Sacramento, Calif., has become junior engineer for the Federal Power Commission, with headquarters in San Francisco, Calif.

Samuel M. Ellsworth, consulting engineer of Boston, Mass., has been appointed lecturer on sanitary engineering design at the Harvard University Graduate School of Engineering under the Gordon McKay Endowment.

Harry A. Ciufi, formerly engaged as resident engineer inspector for the PWA on the construction of buildings for the Golden Gate International Exposition, has been transferred to Hilo, Hawaii, on the construction of a concrete arch bridge over the Wailuku River.

Aksel P. Andersen, until recently with Moran, Proctor and Freeman, of New York City, has accepted an appointment as professor of statics and steel bridges in the Norway Institute of Technology, with headquarters in Trondheim, Norway.

Ambrose John Malloy is now employed by the Board of Transportation of New York City as inspector of steel on the construction of the Sixth Avenue subway. He was previously junior engineer for the New York Central Railroad.

Frank L. Dieter, previously civil engineer for the FSA at Wauwatosa, Wis., has become county planning engineer for Arlington County, Virginia, with headquarters at Arlington.

Theodore B. Parker, chief construction engineer for the Tennessee Valley Authority, has been appointed chief engineer and will serve the organization in both capacities. His headquarters are in Knoxville, Tenn.

Fred E. Swineford has been appointed chief engineer of the bureau of tests for the Ohio State Highway Testing Laboratory at Ohio State University, Columbus. Until recently Mr. Swineford was engineer for the Public Works Administration in Columbus.

Maurice Gould, formerly junior engineer for the Bureau of Highways, Brooklyn, N.Y., is now engineering assistant in the watershed division of the New York City Board of Water Supply. He is located at Ellenville, N.Y.

Jesse E. Buchanan, until lately research engineer for the Asphalt Institute, San Francisco, Calif., has been made dean of the College of Engineering at the University of Idaho.

Earl I. Brown, colonel, Corps of Engineers, U. S. Army, and division engineer at Richmond, Va., has been granted a leave of absence prior to taking his retirement.

Harold G. Sours, consulting highway engineer for the Truscon Steel Company, Youngstown, Ohio, has been appointed to the Ohio State Board of Registration for Engineers and Surveyors for a term ending in 1942.

R. M. Gillis has been promoted from the position of district engineer for the California State Division of Highways, at Fresno, Calif., to that of construction engineer of the Division, succeeding the late C. S. Pope.

Hal H. Hale has resigned as city engineer of Knoxville, Tenn., to join the engineering staff of the Tennessee Valley Authority.

Robert E. Baylor is now employed in the Federated Metals Division of the American Smelting and Refining Company, with headquarters at Whiting, Ind.

William J. Cox, who has been assistant professor of engineering mechanics at Yale University, has been appointed highway commissioner of Connecticut, the office to continue until the 1939 legislative session.

Lewis Van Carpenter, professor of sanitary engineering at New York University, has been made director of the new sanitary engineering laboratory, which was dedicated last fall.

Compere Loveless, formerly a draftsman in the Ambridge (Pa.) plant of the American Bridge Company, is now on the engineering staff of the Pomona Pump Company at Pomona, Calif.

Edward W. Roemer has become connected with James Stewart and Company, of Boston, Mass. Previously he was building commissioner for the city of Boston.

Irving G. Grundel, who for the past year has been in southern Peru, where he was in charge of the design and construction of an aerial wire rope tramway, has returned to the United States and is again with the Amalgamated Sugar Company at Nyssa, Ore.

Alexander V. Karpov has left the engineering division of the Aluminum Company of America in order to devote his entire time to private practice, specializing in hydraulic and structural engineering. His office is in the Grant Building, Pittsburgh, Pa.

Carl A. Bock has been appointed chief consulting engineer of the Tennessee Valley Authority in Knoxville, Tenn. He was formerly assistant chief engineer of this organization.

L. J. Addicott will retire as head of the civil engineering department at Ohio University at the close of the present academic year. Professor Addicott has been in the service of the university since 1904, when he organized the department of civil engineering. Since 1922 he has also been supervising architect for the university.

DECEASED

Walter Hinds Allen (M. '08) captain, C.E.C., U. S. Navy, died suddenly at his home in San Francisco, Calif., on April 19, 1938, at the age of 63. From 1898 to 1903 Captain Allen was in railroad engineering work in this country and Mexico. In the latter year he became connected with the Civil Engineer Corps of the Navy. Captain Allen's posts included Norfolk, Va., and Washington, D.C., and for the past two years he had served as public works officer for the Twelfth Naval District, with headquarters in San Francisco.

Richard Birbeck (M. '28) of New York City, died there on December 6, 1937, at the age of 77. Mr. Birbeck's early career was with the Santa Fe Railroad, the Iron Mountain Railway, and the Missouri Pacific. Except for a two-year period as chief engineer of the Atlantic Fruit Company, he was with the Cuba Railroad Company from 1901 to 1923, as assistant engineer, chief draftsman, assistant chief engineer, and chief engineer, successively. He retired in 1923 but continued to do occasional pieces of work for the Cuba Company.

Guy William Carlton (M. '25) vice-president and treasurer of the Harding-Carlton Corporation, of Buffalo, N.Y., died in Johns Hopkins Hospital, Baltimore, Md., on May 1, 1938, at the age of 63. During the war he was a major in the regular army in charge of cantonment construction. In 1918 Major Carlton moved to Buffalo and became vice-president of the John W. Cowper Company, general contractors. He held this position until 1936 when he and Louis A. Harding formed their own company in Buffalo.

Burt Leo Craig (Assoc. M. '30) structural engineer of Long Beach, Calif., died at Sawtelle, Calif., on April 8, 1938, at the age of 44. As chief structural engineer for the Long Beach (Calif.) Harbor Department from 1928 to 1934, he designed and supervised the construction of bulkheads, hydraulic fill, wharves, transit sheds, and other structures. At one time Mr. Craig was structural and mechanical engineer for the U. S. Smelting, Refining and Mining Company at Salt Lake City and during the war he served as a second lieutenant in the U. S. Army.

Ambrose Goulet Grandpré (M. '25) engineer and contractor of Chicago, Ill., died at his home on April 24, 1938, at the age of 54. A specialist in the construction of Chicago skyscrapers and theaters, Mr. Grandpré was superintendent of construction for several engineering and architectural firms in that city during the period, 1909 to 1923. From 1923 to 1926 he served as vice-president of the Chicago contracting firm, Bierd, Lydon and Grandpré, Inc., and in 1926 he became president of the firm.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Carl Ewald Grunsky, Jr., (M. '22) for the past ten years general superintendent of the East Bay Municipal Utility District, died in Oakland, Calif., on March 22, 1938, at the age of 53. In 1913, after some years as a mining engineer in the West and South America, Mr. Grunsky became an engineer for the American Engineering Corporation, remaining until 1917. In the latter year he enlisted and served overseas as a captain, Corps of Engineers, U. S. Army. Mr. Grunsky joined the staff of the East Bay Municipal Utility District as district engineer in 1924, and in 1928 was made general superintendent.

John Christopher Haskins (Assoc. M. '17) of Newbern, Tenn., died on February 8, 1937, at the age of 47. From 1910 to 1917 Mr. Haskins was with the Louisville and Nashville Railroad Company as draftsman, assistant engineer, and assistant to the chief engineer, successively. Then for a number of years he was chief engineer of the Louisville Bridge and Iron Company, finally becoming president.

Roy Bagley Hayes (Assoc. M. '11) construction engineer for the Treasury Department at Dresden, Tenn., died on October 22, 1937, in McKenzie, Tenn. He was 65. Mr. Hayes was with the U. S. Treasury Department from 1903 on, serving much of the time as superintendent of construction on the erection of many public buildings. For a time he also was a contractor in Lexington, Ky.

Josiah Raymond Johnston (M. '26) superintendent of construction and repair for the St. Paul (Minn.) Department of Public Works, died on April 13, 1938, at the age of 48. During the war Mr. Johnston served as lieutenant and, later, captain in the Corps of Engineers, U. S. Army. In 1923 he became assistant superintendent of construction and repair for the city of St. Paul, and in 1937 was made superintendent. He also served as assistant city engineer.

John Nelson Ostrom (M. '90) retired civil engineer of East Randolph, N.Y., died January 30, 1938, in Chicago, Ill., at the age of 86. In 1888, after engineering experience with the Chicago, Burlington and Quincy Railroad and the Gulf, Colorado and Santa Fe Railroad, Mr. Ostrom established a bridge engineering practice in New York City. Later he moved his office to Pittsburgh, Pa. For a number of years prior to his retirement in 1936, Mr. Ostrom was consulting bridge engineer for the Chicago, Burlington and Quincy Railroad, with headquarters in Chicago.

Rennick Rubenell Paine (Assoc. M. '18) died at his home in Manhattan, Kans., on April 1, 1938, at the age of 52. Mr. Paine was engaged on the construction of the Wichita (Kans.) Union Terminal and the Denver Union Terminal. He served as assistant engineer for the Union Pacific Railroad and, for a number of years, was superintendent of Battey and Kipp, Inc., of Chicago. During the war Mr. Paine served as technical assistant in the Construction Division of the U. S. Army.

William Jackson Roberts (M. '07) consulting engineer of Tacoma, Wash., died at his home there on April 6, 1938, at the age of 78. From 1895 to 1908 he was, successively, assistant and associate professor of civil engineering at Washington State College, and from 1908 on he maintained a consulting practice in Tacoma. During the latter period he also served for several years as Washington State Highway Commissioner and, from 1914 to 1923, was chief engineer for the Intercounty River Improvement Project.

Laurence Patrick Ryan (Affiliate '09) a member of the Ryan Company, of Chicago, Ill., died suddenly on December 11, 1937, at the age of 58. From 1902 to 1908 Mr. Ryan was general manager of the Citizens Construction Company, of Chicago, and from the latter year until his death he was a member of the firm, the Ryan Company, contractors on all kinds of general construction.

Frank Forrest Sinks (M. '07) consulting engineer, died at his home in Medina, Wash., on April 14, 1938, at the age of 64. In 1901, Mr. Sinks became principal assistant to T. L. Condron, consulting engineer of Chicago, and five years later, was made a member of the firm of Condron and Sinks. In 1911 Mr. Sinks established a consulting practice in Seattle, Wash.

Frederick William Ullius (Assoc. M. '25) special assistant city engineer of Milwaukee, Wis., died on April 28, 1938, at the age of 50. From 1913 to 1923 Mr. Ullius was village engineer of Shorewood, Wis., and from 1923 to 1928 chief engineer of sewers for Milwaukee. In 1928 he was made special assistant city engineer. At the time of his death Mr. Ullius was serving as secretary-treasurer of the Milwaukee Section.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From April 10 to May 9, 1938, Inclusive

Additions to Membership

Ackerman, Manuel (Assoc. M. '38), Engr., Irrig. Dept., Union of South Africa, Box 399, Pretoria, Union of South Africa.

Allen, Harvey Hicks (Assoc. M. '38), Asst. to State Highway Engr., State Highway Dept., Box 1019, Dallas, Tex.

Anderson, Kenneth Boyer (Assoc. M. '37), Care, State Highway Dept., Chillicothe, Ohio.

Appleget, Harlan Jackson (Jun. '37), 215 North Sixth St., Hannibal, Mo.

Arroyo, Raoul Nicholas (Jun. '37), 1924 West Erie Ave., Philadelphia, Pa.

Barraza, Louis Julius (Assoc. M. '37), Asst. Res. Engr., State Div. of Highways, 211 State Bldg., San Francisco (Res., 630 First St., Pleasanton), Calif.

Berg, Merlin Hanson (Jun. '38), Junior Engr., U. S. Engr. Office, St. Paul (Res., 983 Eighteenth Ave., S.E., Minneapolis), Minn.

Bogema, Marvin (Jun. '38), Civ. Engr., Greeley & Hansen, 611 East Main, Hoopeston, Ill.

Bohmann, George (Jun. '38), Inspection Engr., Pittsburgh Testing Laboratory (Res., 4500 North Harding Ave.), Chicago, Ill.

Brammer, Paul Edwin (Jun. '37), 602 Washington Ave., Huntington, W.Va .

Cahn, Charles Alexander (Jun. '38), Civ. Engr. and Surv., 839 Chapel St., New Haven, Conn.

Cole, Willard Earl (Jun. '37), Hydrographer, Los Angeles County Flood Control Dist., 760 Elmira St., Pasadena, Calif.

Cooke, Charles Wallace (Assoc. M. '38), Div. Engr., for City Engr. (Res., 9 Madison St.), Hartford, Conn.

Cooke, Ernest Edward (Assoc. M. '38), Vice-Pres. and Gen. Mgr., Thomasville Stone & Lime Co., Thomasville (Res., 567 Madison Ave., York), Pa.

Corwin, Harold Jay (Jun. '38), Eng. Aide, Highway and Railroad Div., TVA, 811 Centenary Ave., Cleveland, Tenn.

Drager, Frederick Eugene (Jun. '38), Instr. in Civ. Eng., Coll. of Eng., Univ. of Idaho, 514 Sweet Ave., Moscow, Idaho.

Drury, Joseph Donahue (Assoc. M. '38), Asst. Highway Engr., State Highway Dept., Hartford (Res., 1378 Chapel St., New Haven), Conn.

Erickson, David William (Assoc. M. '38), Road Engr., U. S. Indian Service, Colville Indian Agency, Nespelem, Wash.

Fuertes, Joaquin Rodriguez (Jun. '37), Junior Engr., Porto Rico Railway Light & Power Co., San Juan, Puerto Rico.

Gilmore, Ross Angus (Assoc. M. '38), Lieut. (j.g.) U. S. Coast and Geodetic Survey, Washington, D.C.

Goldsmith, Robert Herman (Jun. '38), 35 West 81st St., New York, N.Y.

Gow, Frederick William (Assoc. M. '38), Senior Civ. Engr., Commonwealth of Massachusetts, Met. Dist. Water Supply Comm., R. F. D., Enfield, Mass.

Greulich, Bernard James (Jun. '37), Junior Engr., Kyle & Co., 405 Michigan Ave., Fresno, Calif.

Heald, Henry Townley (Assoc. M. '38), Dean and Prof. of Civ. Eng., Armour Inst. of Technology, 3300 Federal St., Chicago, Ill.

Heft, George Albert (Jun. '37), Constr. and Maintenance Clerk, Shell Petroleum Corporation, 520 Canal Bank Bldg. (Res., 8139 Cohn St.), New Orleans, La.

Henshaw, Jesse Robinson (Jun. '37), Sales Engr., Pure Iron Culvert & Mfg. Co., 1706 North East 27th Ave., Portland, Ore.

Heyl, Edward Randolph (Assoc. M. '38), Supt., Public Works Dept., Philadelphia Navy Yard, Philadelphia, Pa. (Res., 205 Plymouth Pl., Merchantville, N.J.)

Hull, Richard Niles (Jun. '37), With Howard F. Bell, Cody (Res., 1708 Grand Ave., Laramie), Wyo.

Huston, Klyde Zieglar (Jun. '38), Care, Am. Steel Derrick Co., Box 2342, Houston, Tex.

James, John Sexton (M. '38), State Engr. (Res., 512 North Rodney St.), Helena, Mont.

Kammer, Herbert Anthony (Assoc. M. '38), Asst. Design Engr., Am. Gas. & Elec. Co., 30 Church St., New York (Res., 269 East Argyle St., Valley Stream), N.Y.

Kelly, Warren Winfield (M. '38), Chf. Engr., A. T. & S. F. Ry., Santa Fé Bldg., Amarillo, Tex.

Kenyon, Edgar Clay, Jr. (Assoc. M. '38), Hydr. Engr., Los Angeles County Flood Control Dist. (Res., 2285 Lorain Rd.), San Marino, Calif.

Larson, Carl Earl, Jr. (Jun. '37), 160 Highland St., Worcester, Mass.

Lichtman, Irving (Assoc. M. '38), Pres., Tri-State Building Co. (Res., 1415 Seventy-Third St.), Brooklyn, N.Y.

McDonald, Everett Keith (Assoc. M. '38), City Engr. (Res., 1341 West Forest Ave.), Decatur, Ill.

McMahan, Leonard Clyde, Jr. (Jun. '37), 2044 Yale North, Seattle, Wash.

Marr, Robert Athelstan, Jr. (M. '38), Prof., Dept. of Civ. Eng., Virginia Military Inst., Lexington, Va.

Matter, Andrew Knox (Jun. '37), Sisseton, S.Dak.

Mortola, Alexis Joseph (Jun. '38), 108 Pembroke Pl., Kew Gardens, N.Y.

Muhlenbruch, Carl William, Jr. (Jun. '37), Testing Engr., Aluminum Co. of America (Res., Aluminum Club), New Kensington, Pa.

Nelson, Jack Minor (Jun. '38), Overseas Road and Toll Bridge Dist., Archer, Fla.

Newmyer (Jun. '37), Box 3, Central City, Nebr.

Ott, Clifford Spencer (Jun. '38), Junior Asst. Engr., Malcolm Pirnie, 25 West 43d St., New York, N.Y.

Ottinger, Newton Harold (Jun. '37), 350 Eighth St., Beaumont, Tex.

Porter, William Henry (Jun. '37), 1419 Goodbar Ave., Memphis, Tenn.

Rawlins, Joe Charles (Jun. '37), Care, Standard Oil Co. of Louisiana, Pipe Line Dept., Shreveport, La.

Reinhardt, Charles Orville (Jun. '38), Asst. Engr., State Water Survey, Urbana (Res., 708 Arlington Court, Champaign), Ill.

Robertson, Dan Duane (Jun. '37), Engr., Soulé Steel Co., 1750 Army Bldg., San Francisco (Res., 1177 Lincoln. Ave., Palo Alto), Calif.

TOTAL MEMBERSHIP AS OF MAY 9, 1938

Members	5,653
Associate Members	6,206
Corporate Members	11,859
Honorary Members	24
Juniors	3,712
Affiliates	78
Fellows	1
Total	15,674

Rosenfeld, Yale (Jun. '37), 2150 Fell St., San Francisco, Calif.

Rouze, Robert Edward (Jun. '37), Box 29, Davenport, Wash.

Scott, Veron Eugene (M. '37), Asst. Director and Secy., State Highway Comm., Little Rock, Ark.

Serrurier, Mark Usona (Assoc. M. '37), Structural Designer, California Inst. of Technology, Pasadena, Calif.

Shanley, Edmund Michael (Jun. '38), Junior Civ. Engr., U. S. Forest Service, San Francisco (Res., 2763 Madera Ave., Oakland), Calif.

Staples, Ercelle Horace (Jun. '37), 404 West Crockett St., Ennis, Tex.

Sternitzke, Robert Frederick (Jun. '38), 252 Madison St., Brooklyn, N.Y.

Thorstenson, Frederick Woodward (Jun. '37), 2282 Carter Ave., St. Paul, Minn.

Volk, Harry Joseph, Jr. (Jun. '37), Structural Draftsman, Bethlehem Steel Co. (Res., 526 Sixteenth Ave.), Bethlehem, Pa.

Wall, Claude Hutchinson (Assoc. M. '38), Associate Prof., Civ. Eng., Ohio State Univ., 113 Brown Hall, Ohio State Univ., Columbus, Ohio.

Webster, Willard Wright (Jun. '38), Rodman, State Water Conservation Comm., Bismarck, N.Dak.

Wheeler, William Thornton (Jun. '38), Senior Structural Draftsman, Los Angeles Union Passenger Terminal, Los Angeles (Res., 180 South Roosevelt Ave., Pasadena), Calif.

Whitty, Howard Charles, Jr. (Jun. '38), Junior Bridge Constr. Engr., Bridge Dept., State Div. of Highways, Box 308, Standish, Calif.

Winn, Herbert Poston (Assoc. M. '38), Associate Engr., U. S. Engr. Office, Tionesta, Pa.

Membership Transfers

Baird, Gordon Gifford (Jun. '32; Assoc. M. '38), Asst. Engr., Grade 1, Oneida County Dept. of Highways, Court House (Res., 1902 Storrs Ave.), Utica, N.Y.

Dawson, Raymond Fillmore (Jun. '24; Assoc. M. '30; M. '38), Testing Engr., Bureau of Eng. Research, Little Campus, Austin, Tex.

Duff, Carl Mathias (Assoc. M. '22; M. '38), Testing Engr., State Dept. of Roads and Irrig.; Prof., Eng. Mech., Univ. of Nebraska, 106 M. A. Bldg., Univ. of Nebraska (Res., 326 North 26th St.), Lincoln, Nebr.

Easterbrooks, Preston Burt, Jr. (Jun. '34; Assoc. M. '38), Plant Engr., Monsanto Chemical Co., Box 162, Anniston, Ala.

Elmendorf, Harold Benjamin (Assoc. M. '30; M. '38), Associate Hydr. Engr., Water Utilization Section, Bureau of Agri. Economics, U. S. Dept. of Agriculture, Washington, D.C.

Graves, Quintin Branson (Jun. '35; Assoc. M. '38), Inst. in Civ. Eng., Dept. of Civ. Eng., Univ. of Texas, Austin, Tex.

Grinter, Linton Eli (Jun. '26; Assoc. M. '29; M. '38), Director of Civ. Eng., and Dean, Graduate Div., Armour Inst. of Technology, 3300 Federal St., Chicago, Ill.

Guy, Leonard Thomas (Jun. '23; Assoc. M. '25; M. '38), Asst. to Civ. Engr., State Electricity Comm., 22 William St., Melbourne, Victoria, Australia.

Hill, William Crawford (Jun. '32; Assoc. M. '38), Junior Engr., State Dept. of Highways, Brainerd, Minn.

Jacka, Samuel Curno (Assoc. M. '28; M. '38), City Engr. (Res., 1720 West Ottawa St.), Lansing, Mich.

Jansen, Carlton B. (Assoc. M. '30; M. '38), Asst. to Gen. Mgr., Dravo Corporation, Contr.

Div., Neville Island Station (Res., 7045 Woodland Ave., Ben Avon P.O.), Pittsburgh, Pa.

Marin, Joseph (Jun. '29; Assoc. M. '38), Asst. Prof., Eng. Materials, Coll. of Eng., Rutgers Univ., New Brunswick, N.J.

Mattern, Donald Heckman (Jun. '26; Assoc. M. '38), Associate Mech. Engr., TVA, 314 Union Bldg., Knoxville, Tenn.

Maynard, Robert Lee (Assoc. M. '31; M. '38), City Engr., City Hall, Asheville, N.C.

Meehan, Andrew Joseph Aloysius (Assoc. M. '30; M. '38), Senior Bridge Engr., State Dept. of Public Works, Div. of Highways, 357 Public Works Bldg. (Res., 2540 Fifth Ave.), Sacramento, Calif.

Monks, John, Jr. (Jun. '31; Assoc. M. '37), Asst. Engr., John Monks & Sons, 438 Broadway, New York, N.Y.

Parker, Charles Fulton (Jun. '28; Assoc. M. '38), Junior Engr., State Highway Comm., Box 63, North Windham, Me.

Smith, Leroy Clarke (Assoc. M. '15; M. '38), Engr.-Mgr., Wayne County Road Comm., 3800 Barlum Tower, Detroit, Mich.

Stanley, William Edward (Jun. '16; Assoc. M. '23; M. '38), Prof., San. Eng., School of Civ. Eng., Cornell Univ., Lincoln Hall, Cornell Univ., Ithaca, N.Y.

Williams, Robert Emil (Jun. '28; Assoc. M. '38), Engr., The Coca-Cola Co., Box 351, Wilmington, Del.

REINSTATEMENTS

Spence, Eugene Vierling, Assoc. M., reinstated April 21, 1938.

RESIGNATIONS

Booker, James Lester, Jun., resigned May 4, 1938.

Brown, Claude Osgood, Assoc. M., resigned April 14, 1938.

Herrick, Thomas Lorimer, Assoc. M., resigned April 26, 1938.

Rasmusson, Irvin Sherman, Assoc. M., resigned April 8, 1938.

Saxe, Louis Steiner, Jun., resigned May 6, 1938.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

June 1, 1938 NUMBER 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in Civil Engineering *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

Adams, Rob Roy, Greenville, S.C. (Age 38.) With J. E. Sirrine & Co., Engrs. Refers to W. R. Crute, H. L. Hagerman, W. S. Lindsay, F. H. Shaw, J. E. Sirrine, W. H. Taylor.

Baird, James Adam, Montgomery, Ala. (Age 31.) Div. Constr. Engr., Alabama State Highway Dept. Refers to W. H. Caruthers, H. J. Friedman, L. Gottlieb, H. H. Houk, R. D. Jordan, H. C. Wells.

Barksdale, John Fowler, Chattanooga, Tenn. (Age 38.) Area Engr., Maps and Surveys Div., TVA. Refers to J. G. Allen, H. H. Hale, H. B. Hooper, N. H. Sayford, G. D. Whitmore, H. A. Wiersema, J. Wright.

Barnes, Chiles Manly, Astoria, N.Y. (Age 49.) Structural Designer, Suchar Process Corporation, Yonkers, N.Y. Refers to R. W. Burpee. E. A. Dockstader, F. D. Hutchinson, J. L. Lamb, I. B. Packman, C. E. Pett, T. S. Williams.

Beeson, James Farr, Tuscaloosa, Ala. (Age 21.) Refers to G. J. Davis, Jr., D. C. A. duPlantier.

Brater, Ernest Fredrich, Ann Arbor, Mich. (Age 26.) Instructor in Civ. Eng., Univ. of Michigan. Refers to L. M. Gram, C. O. Wisler.

Brown, Frederick Raymond, Vicksburg, Miss. (Age 26.) Jun. Engr., U. S. Waterways Experiment Station. Refers to S. J. Buchanan, J. J. Doland, M. L. Enger, W. C. Huntington, N. R. Moore, T. C. Shedd.

Brown, John Frazey, Chicago, Ill. (Age 58.) Chf. Engr., Illinois Steel Co., South Works. Refers to A. P. Boysen, E. J. Fucik, A. Marston, A. Montzheimer, E. S. Nethercut, A. F. Reichmann, H. van Zandt.

Burge, Eugene Field, Los Angeles, Calif. (Age 28.) Jun. Highway Engr., California State Div. of Highways. Refers to W. V. Brady, S. V. Cortelyou, K. M. Fenwick, A. N. George, M. W. Gewertz, A. D. Griffin, R. A. Wagner.

Chapman, George Edward, Lawrence, Kans. (Age 25.) With Kansas Highway Comm., Planning Survey Dept. Refers to C. M. Barber, H. D. Barnes, G. W. Bradshaw, R. D. Finney, W. C. McNown, R. B. Wills.

Cremer, Randall, Pelham Manor, N.Y. (Age 47.) Vice-Pres., Frederick Snare Corporation, New York City. Refers to O. H. Ammann, C. W. Bryan, S. Hardesty, F. J. Litter, T. B. Parker, E. S. Skillin, C. M. Spofford.

Cummins, Thomas Vincent, Rolla, Mo. (Age 29.) Asst. Topographic Engr., U. S. Geological Survey, mapping Heart Butte (N.Dak.) quadrangle. Refers to C. E. S. Bardsley, J. B. Butler, E. W. Carlton, D. Kennedy, C. L. Sadler.

Curtis, Earl Howard, Asheville, N.C. (Age 32.) Asst. Engr., U. S. Geological Survey. Refers to E. D. Burchard, D. M. Corbett, N. C. Grover, H. B., Kinnison, J. L. Lamson, R. L. Maynard, C. G. Paulsen.

Dalton, John Patrick, New York City. (Age 34.) Refers to M. T. Bolmer, F. E. Cudworth, L. D. Gilfillan, G. S. Rinehart, W. J. Shea.

Davis, Douglas Charles, Vicksburg, Miss. (Age 28.) Asst. to Director, U. S. Waterways Experiment Station. Refers to G. R. Clemens, G. H. Matthes.

Derby, Frank Holliday, St. Louis, Mo. (Age 53.) Associate Prof., Dept. of Civ. Eng., Washington Univ. Refers to C. E. S. Bardsley, C. E. Galt, W. W. Homer, E. O. Sweetser, J. L. Van Ornum, F. C. Woermann.

Dillon, Frederick Peter, Parker Dam, Calif. (Age 37.) Contr.'s Engr. with Winston Bros. Co. & Wm. C. Crowell. Refers to J. C. Agnew, F. T. Hillman, A. Jones, E. Maag, L. S. Oakes, V. L. Peugh.

Dodds, John Brydone, Seattle, Wash. (Age 23.) Refers to G. E. Hawthorn, A. L. Miller, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

Drescher, Francis Andrew, Columbus, Ohio. (Age 25.) Asst. Engr., Ohio Highway Board of Inquiry. Refers to G. E. Barnes, M. S. Douglas, C. T. Morris, F. L. Plummer, J. R. Smart.

Eldridge, Albert Matthews, Atlanta, Ga. (Age 22.) With Georgia Power Co. Refers to M. T. Singleton, F. C. Snow.

Ele, Vern Jennings, Paraiso Springs, Calif. (Age 41.) Assoc. Bridge Engr., Bridge Dept., California Div. of Highways. Refers to J. Cherno, J. Gallagher, I. O. Jahlstrom, F. W. Panhorst, J. E. Winter.

Farris, Howard Carl, Sacramento, Calif. (Age 38.) Res. Engr. Bridge Dept., State Div. of Highways. Refers to V. A. Endersby, T. E. Ferneau, W. S. Kingsbury, Jr., H. L. Lyon, G. Mattis, H. M. Stafford, A. Thain.

Ferguson, George Ernest, Washington, D.C. (Age 32.) Associate Engr., Sec. of Reports, U. S. Geological Survey. Refers to W. E. Armstrong, J. B. Cox, C. E. Ellsworth, N. C. Grover, J. F. Kunesh, C. G. Paulsen.

Ferrer-Vaillant, Alberto, Santiago, Cuba. (Age 27.) Second and (occasionally) Chf. Engr., Office of Public Works. Refers to E. J. Chibas, N. Colas, J. A. Cosculluela y Barreras, A. F. deJongh.

Frost, Daniel Carter, Newark, N.J. (Age 33.) Instructor in Civ. Eng., Newark Coll. of Eng.; also (evenings) Instructor in applied mechanics and mathematics, Newark Technical School. Refers to H. B. Alvord, H. N. Cummings, J. A. Darling, W. S. LaLonde, Jr., R. R. Marsden, A. P. Richmond, Jr.

Hall, Wesley Miles, Brownwood, Tex. (Age 33.) Res. Engr., Div. 23, Brown and Coleman Counties, Texas State Highway Dept. Refers to R. H. Clinger, J. A. Focht, E. N. Gustafson, C. S. Henning, Jr., M. P. von Homeyer, A. F. Moursund, E. E. Pittman, H. C. Porter, A. D. Schmid, W. W. Wilkerson.

Heykoop, Jan, Enka, N.C. (Age 42.) Chf. Bldg. Engr., American Enka Corporation. Refers to E. D. Burchard, J. Dave, H. J. Hassler, S. B. Lincoln, C. B. Scott, J. B. Snethlage, C. E. Waddell.

Hughes, Joseph Francis, Omaha, Nebr. (Age 42.) Gen. Supt., Phoenix Eng. Corporation. Refers to W. H. Campen, D. W. Cole, E. T. Foster, A. C. Giesecke, A. T. Larned, K. E. Vogel.

Jett, Daniel Boone, State College, N.Mex. (Age 51.) Prof. of Civ. Eng., New Mexico State Coll. Refers to E. L. Barrows, P. R. Burn, S. F. Crecelius, J. H. Dorroh, H. B. Elmendorf, B. Johnson, T. M. McClure, S. Sims.

Keaveny, Felix James, Yonkers, N.Y. (Age 34.) Structural Draftsman, Standard Oil Co., Elizabeth, N.J. Refers to M. R. Alexander, E. M. Browder, Jr., R. E. Goodwin, R. L. Pfau, S. Rosenberg.

LeVan, Howard Aaron, Jr., Harrisburg, Pa. (Age 31.) Private practice, surveys, subdivision planning, etc. Refers to G. S. Beal, N. S. Buckbee, C. F. Class, J. W. Mangan, J. V. B. Wells.

Levine, Jack George, Brooklyn, N.Y. (Age 28.) Draftsman, WPA. Refers to F. E. Foss, M. H. Van Buren, J. P. J. Williams.

Lindeman, Marvel Fred, Detroit, Mich. (Age 33.) Instructor in Civ. Eng., Wayne Univ. Refers to H. Cross, W. C. Huntington, D. Newton, T. C. Shedd, W. M. Wilson.

Lowry, Ralph, Boulder City, Nev. (Age 49.) Constr. Engr., U. S. Bureau of Reclamatiou, Boulder Canyon project. Refers to L. C. Hill, J. Hinds, J. C. Page, J. L. Savage, M. K. Snyder, R. F. Walter, W. R. Young.

Lyder, Audley Arnott, Port-of-Spain, Trinidad, B.W.I. (Age 35.) Dist. Engr., Public Works Dept., Trinidad. Refers to H. R. Gabriel, R. E. Goodwin, A. W. Green, Jr., M. Henry, J. C. Rathbun, A. W. Tolander.

McClendon, Collins Hakes, Glendale, Calif. (Age 30.) U. S. Mineral Surveyor, General Land Office. Refers to S. P. Laverty, O. C. Tretten.

McLaurin, Banks, Austin, Texas. (Age 49.) Asst. Prof. of Civ. Eng., University of Texas. Refers to E. C. H. Bantel, P. M. Ferguson, S. P. Finch, J. A. Focht, R. S. Guinn, H. R. F. Helland, T. U. Taylor, G. G. Wickline.

Mendez Jimenez, Orlando Ramon, Penuelas, Puerto Rico. (Age 31.) With Govt. of Puerto Rico, as Field Supt., Penuelas Sec. of Garzas Hydro-electric project. Refers to S. R. Cuevas Bustemante, G. M. Font, M. Font, W. M. Hall, A. S. Lucchetti-Otero, G. E. Padilla, P. C. Pagan, W. W. Schlecht, R. M. Snell, H. H. Steinhauser, F. Towle.

Meredith, Wayland Halteman, Jefferson City, Mo. (Age 44.) Traffic Engr., Western Cataphote Corporation of Toledo, Ohio, in charge of engineering on sales promotion work with highway departments, Atlantic Coast to Rocky Mts. Refers to R. Adams, R. B. Brooks, R. W. Brooks, C. W. Brown, P. H. Daniells, S. M. Rudder, F. W. Sayers.

Miller, John Howard, New York City. (Age 47.) Sales Engr., Kerlow Steel Flooring Co., Jersey City, N.J. Refers to H. J. Krueger, E. J. Moore, J. P. H. Perry, P. L. Price, E. L. Tarof.

Nelson, Toivo John, Seattle, Wash. (Age 25.) Refers to A. L. Miller, C. C. More, F. H. Rhodes, Jr., R. B. Van Horn.

Newton, Carroll Thompson, Ft. Peck, Mont. (Age 27.) 2d Lieut., Corps of Engrs., U. S. Army; Gen. Eng. Asst., U. S. Engr. Office. Refers to P. B. Heidema, C. Kittrell, E. G. Plank.

Norris, James Alexander, Shamokin, Pa. (Age 34.) Chf. Engr. and Gen Supt., Dick-Smith Corporation, Hazelton, Pa. Refers to F. A. Barnes, C. H. Buckius, W. J. Carroll, L. L. Lessig, J. E. Perry.

Ockerblad, Andrew Merritt, Lawrence, Kans. (Age 51.) Associate Prof. of Applied Mechanics, Univ. of Kansas. Refers to N. W. Bowden, W. Bowie, I. C. Crawford, F. M. Dawson, E. H. Pagenhart, F. Thomas, C. C. Williams.

Roberts, Harrison Harding, Okanogan, Wash. (Age 29.) Draftsman, County Engr.'s Office. Refers to F. M. Berry, S. C. Jayne, D. R. McFarland, C. W. Nash, R. H. Thomson.

Salmon, Richard, Hamden, Conn. (Age 33.) Chf. Engr. and Supt., The Foundation Co. in Oruro, Bolivia. Refers to C. T. Bishop, C. W. Bolieau, R. P. Carr, G. P. deForest, J. W. Doty, H. O. Sharp, H. J. Tippet.

Saunders, William Kennon, Detroit, Mich. (Age 38.) Member of firm, Couse & Saunders, Gen. Contrs. Refers to W. L. Couse, G. H. Fenkell, W. C. Hirn, L. G. Lenhardt, J. W. Moore, A. B. Morrill, R. Norris.

Sexauer, Harvey Robert, Ankeny, Iowa. (Age 27.) Cadastral Engr., U. S. Dept. of Agriculture, Bureau of Biological Survey. Refers to R. A. Caughey, A. H. Fuller, W. E. Galligan, F. Kerekes, L. O. Stewart.

Shappert, Frederick William, Jr., Belvidere, Ill. (Age 36.) Pres., Shappert Eng. Co. Refers to G. H. Baker, G. F. Burch, W. S. Gearhart, C. M. Hathaway, C. J. McLean, C. J. Moritz.

Smith, George Wallace, Raleigh, N.C. (Age 43.) Prof. and Head, Dept. of Eng. Mechanics, North Carolina State Coll. Refers to H. G. Baity, W. G. Geile, T. F. Hickerson, T. S. Johnson, C. L. Mann, T. Saville, H. Tucker.

Smith, Harlen, Seattle, Wash. (Age 24.) Refers to A. L. Miller, C. C. More, F. H. Rhodes, Jr.

Snyder, William Oscar, Frankfort, Ky. (Age. 39.) Field Engr., Portland Cement Association. Refers to C. W. Lovell, H. D. Palmore, A. W. Rohlwing, W. W. Sanders, D. V. Terrell, W. S. Todd, J. S. Watkins.

Spencer, Walter Earl, Seattle, Wash. (Age 33.) Jun. Engr. (Civ.), U. S. Engr. Dept., designing hydraulic works, etc. Refers to H. J. M. Baker, J. E. Buchanan, I. C. Crawford, W. L. Holmes, F. W. Phipps, H. J. Wild, H. C. Witte.

Staley, Howard Raymond, Cambridge, Mass. (Age 38.) Research in masonry materials, Massachusetts Institute of Technology. Refers to C. B. Breed, J. J. Hurley, J. D. Mitsch, D. Peabody, Jr., W. C. Voss.

Tanner, Burford Maurice, San Francisco, Calif. (Age 30.) Engr.-Draftsman, Shell Oil Co. Refers to T. A. Munson, G. L. Parker, A. B. Purton, J. J. Richey.

Taylor, Marvin, Birmingham, Ala. (Age 43.) Div. Maintenance Engr., Alabama Highway Dept. Refers to H. D. Burnum, W. Finnell, H. H. Houk, R. D. Jordan, J. H. Mayer, J. R. Peavy.

Thomas, Albert Lane, Pittsburgh, Pa. (Age 27.) Surveyman and Jun. Engr., Research Sec., U. S. Engrs., War Dept. Refers to J. E. Deignan, G. A. Guyer, P. A. Perrin.

Thompson, Henry Loren, Chicago, Ill. (Age 26.) Office Engr., Robert W. Hunt Co., Engrs. Refers to C. L. Allen, C. M. Cade, R. E. Hutchins, R. L. McCormick, R. H. Vose.

Van Camp, Roy K, Atlanta, Ga. (Age 44.) Engr. Examiner and Chf. Engr., PWA (Florida), FEA of PW. Refers to J. E. Bomar, C. E. Burleson, E. V. Camp, J. H. Dowling, H. J. Morrison, W. I. Nolen, G. A. Youngberg.

Villanueva U, Eduardo Antonio, Caracas, Venezuela. (Age 32.) Aide-de-camp of President of Venezuela, and Technical Advisor, Aide-de-Camp Corps. Refers to E. Aguerrevere, J. M. Bayot, J. J. Collins, V. de Chelminski, J. M. Ibarra Cerezo, J. R. Stubbins, H. C. Willcox.

Watkins, Robert Bruce, Pittsburgh, Pa. (Age 27.) Continuing Property Record Dept. Penna. Water Co. Refers to G. S. Davison, C. G. Dunnells, C. L. Fox, C. N. Haggart, W. C. Hawley, C. B. Stanton, J. D. Stevenson.

Wefring, Peter Meyer, Calcutta, India. (Age 39.) Designer, Braithwaite, Burn & Jessop Constr. Co., Ltd. Refers to E. J. Muller, G. Wilson.

Werner, Gustave George, Jr., Miami Beach, Fla. (Age 30.) Res. Engr. with Malcolm Pirnie, New York City. Refers to C. F. Bornefeld, T. F. Hubbard, M. Pirnie, C. A. Renshaw, R. W. Sawyer, 3d, J. T. Thompson.

Wilkerson, Byron Emmett, Hamilton, Mont. (Age 23.) Refers to A. L. Miller, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

Wilson, Thomas Evans, Jr., Bamberg, South Carolina. (Age 28.) Asst. Res. Engr., South Carolina Highway Dept. Refers to A. Epstein, T. K. Legare, L. S. Le Tellier.

Woodman, Lorrin Ewart, Cambridge, Mass. (Age 22.) Refers to G. M. Fair, A. Haertlein, M. Pirnie.

Wright, Chester Fredrick, Lake Worth, Fla. (Age 45.) Member, State Board of Eng. Examiners; City Engr.; private practice. Refers to J. M. Boyd, G. S. Brockway, E. Friedman, M. R. Kays, G. Kingsley, W. E. Robinson, W. A. Smith.

Young, Fred Owen, Honolulu, Hawaii. (Age 36.) Asst. Engr. Inspector, FEA of PW. Refers to J. F. Kunesh, G. K. Larrison, V. B. Libbey, F. Ohrt, B. F. Rush, K. A. Sinclair, C. D. Tarleton.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Alvord, Henry Bissell, Assoc. M., Boston, Mass. (Elected June 6, 1927.) (Age 53.) Prof. and Head, Dept. of Civ. Eng., Northeastern Univ.; Treas., Massachusetts Federation of Planning Boards. Refers to A. W. Dean, C. R. Gow, K. R. Kennison, L. E. Moore, A. L. Scott, A. L. Shaw, H. Sutherland, F. E. Winsor.

Dalen, John Albert, Assoc. M., New York City. (Elected June 16, 1919.) (Age 55.) Cons. Structural Engr. Refers to G. B. Andreen, H. Carlstedt, A. Embury, II, P. M. Infante, L. C. Jordan, E. D. Kahlert, V. V. Tchikoff.

Harris, Roy Monte, Assoc. M., Seattle, Wash. (Elected Nov. 28, 1932.) (Age 37.) Chf., Div. of Public Health Eng., State Dept. of Health. Refers to A. D. Butler, J. W. Cunningham, C. E. Green, C. M. Howard, R. G. Tyler, R. B. Van Horn.

Johnston, Clair Crawford, Assoc. M., Detroit, Mich. (Elected Nov. 18, 1935.) (Age 39.) Prof. of Civ. Eng., Univ. of Detroit. Refers to W. H. Adams, L. M. Gram, W. C. Hirn, C. W. Hubbell, R. L. McNamee, R. H. Sherlock, H. A. Shuptrine.

Lush, Cuyler Warfield, Assoc. M., Plattsburg, N.Y. (Elected Junior Feb. 4, 1908; Assoc. M. May 31, 1910.) (Age 54.) Constr. Engr., Clinton Prison, Dannemora, N.Y. Refers to F. S. Crowell, H. J. Deutschbein, R. G. Finch, G. L. Freeman, W. H. Gravell, L. J. Hotchkiss, J. H. O'Brien, F. A. O'Hare, H. O. Schermerhorn.

O'Brien, Daniel Bernard, Assoc. M., Syracuse, N.Y. (Elected Junior April 3, 1906; Assoc. M. May 3, 1910.) (Age 55.) Pres. and Engr., O'Brien Hoolihan Contr. Co., Inc.; also Valuation Engr., and Court Expert on real property, and Fee Appraiser HOLC. Refers to H. B. Brewster, W. W. Cronin, C. S. Herrick, G. D. Holmes, L. Mitchell, N. F. Pitts, Jr., S. D. Sarason, G. D. Williams.

Ramey, Allen, Assoc. M., Kansas City, Mo. (Elected Nov. 10, 1930.) Major, U. S. Army Reserves, commanding 1st Batt., 362 Engrs. (Gen Serv.) Constr. Supt., J. F. Pritchard Co., Engrs. and Contrs. Refers to J. F. Brown, F. M. Cortelyou, A. C. Everham, E. E. Howard, H. C. Tammen, N. T. Veatch, Jr., A. R. Young.

Rowe, Robert Rich, Assoc. M., Chicago, Ill. (Elected Oct. 30, 1933.) (Age 40.) Company Archt. and Engr., Montgomery Ward & Co. Refers to J. C. Doucha, R. C. Gowdy, C. S. Lambie, T. K. Legare, R. R. Rowe, E. F. Sibbert.

Siegler, George, Assoc. M., Jersey City, N.J. (Elected May 25, 1931.) (Age 42.) Pres., Chf. Engr., and Gen Mgr., Geo. Siegler Co. Refers to O. H. Ammann, C. S. Gleim, G. L. Lucas, O. Singstad, R. Smillie, E. W. Stearns.

Stine, Walter Pearce, Assoc. M., Beaumont, Tex. (Elected Oct. 1, 1912.) (Age 55.) Div. Supt., Gulf Pipe Line Co. Refers to W. A. Blakemore, C. C. Crew, W. B. Livesay, J. C. McVea, W. H. Mead, A. J. Wise.

Tribble, John Furman, Assoc. M., Birmingham, Ala. (Elected Nov. 9, 1936.) (Age 37.) Materials Engr., Alabama Highway Dept. Refers to J. A. C. Callan, W. Finnell, H. H. Houk, R. D. Jordan, J. H. Mayer, J. R. Peavy, A. C. Polk.

Turnbull, Paul Horne, Assoc. M., Llanerch, Pa. (Elected June 1, 1920.) (Age 50.) In charge of inspection of construction, school contracts for the School Dist. of Philadelphia. Refers to J. Adler, W. D. Allardice, H. H. Demmert, W. H. Gravell, J. P. H. Hallahan, J. A. Renshaw, E. D. Walker, W. E. Witte.

Ward, Richard B, Assoc. M., Arlington, Calif. (Elected Feb. 27, 1933.) (Age 49.) Asst. Engr., and Res Engr. on construction of Cajalco Dam, Metropolitan Water Dist. of Southern California. Refers to J. L. Burkholder, W. L. Chadwick, R. B. Diemer, J. Hinds, S. A. Kerr, A. M. Rawn.

Williams, Herbert Lester, Assoc. M., New Orleans, La. (Elected Oct. 26, 1931.) (Age 36.) Civ. Engr., 2d Dist., U. S. Engr. Dept. Refers to J. F. Coleman, N. E. Lant, W. B. Smith, M. C. Tyler, W. S. Winn, B. R. Wood, C. A. D. Young.